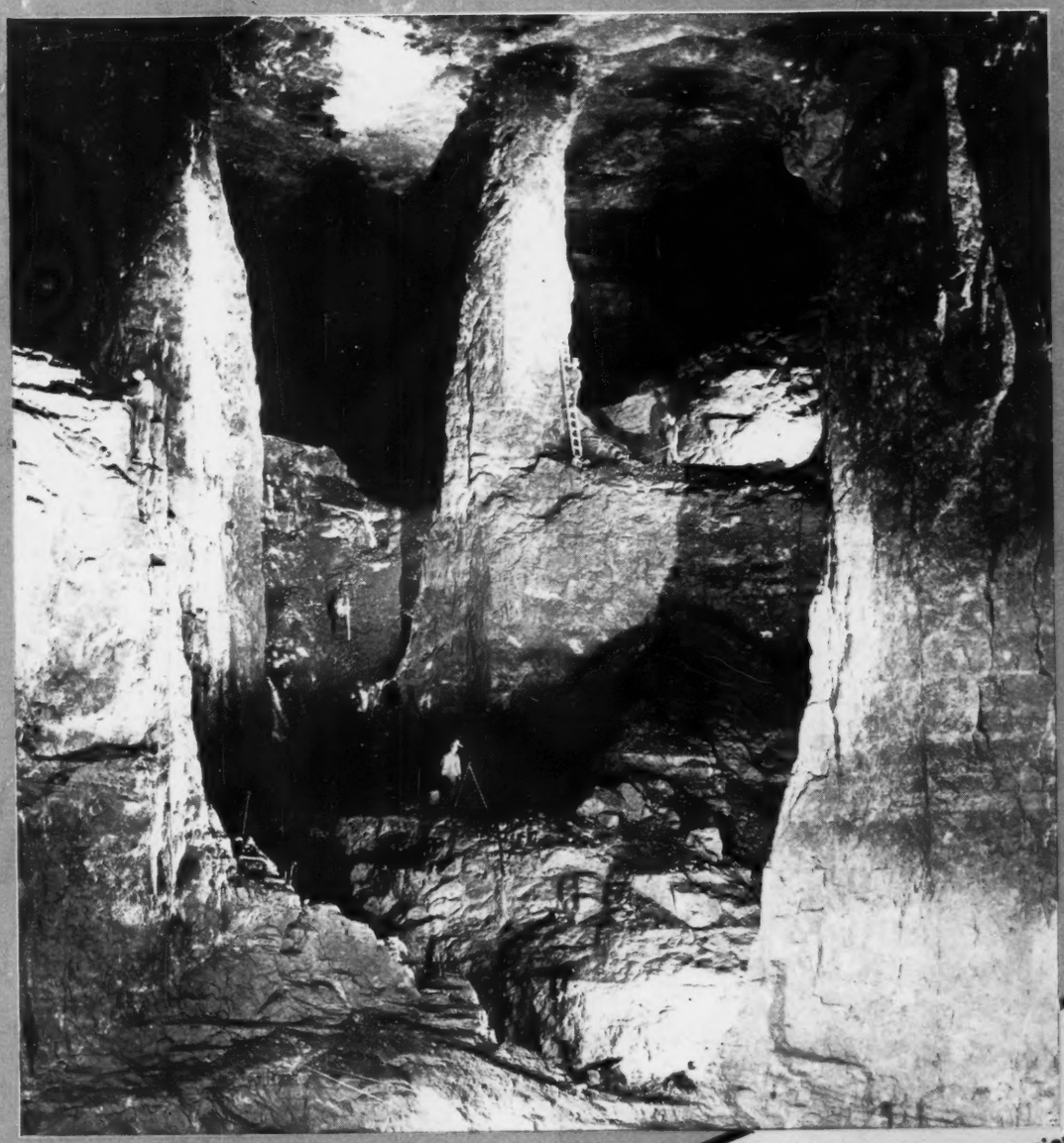
JAN 22 1942

ENGINEERING AND MINING JOURNAL

JANUARY, 1942



Stope and pillars in a mine of St. Joseph Lead Co., Southeast Missouri

In this issue

Magnesium for Victory
Domestic Manganese From Butte—Placer Valuation—II
Reclaiming Metals and Alloys From Industrial Wastes
Mining on the Menominee—The Evasee on an Exhaust Fan
Potash Company of America's Operations at Carlsbad—
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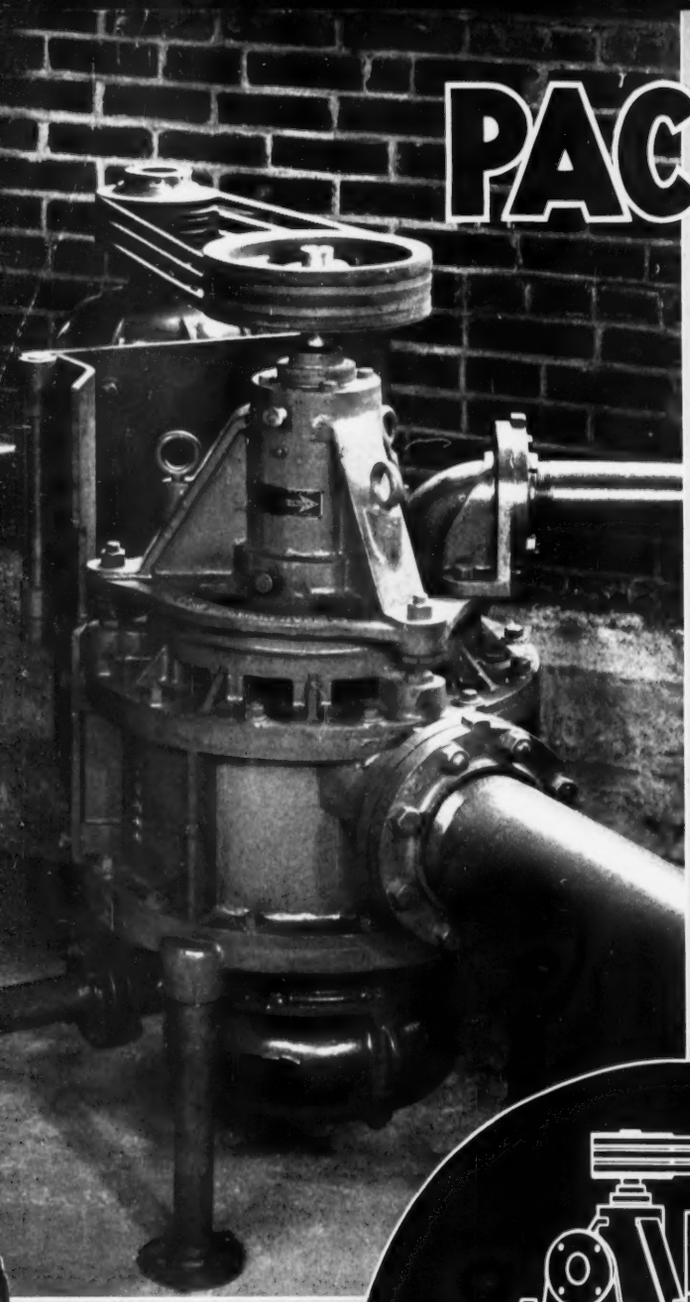

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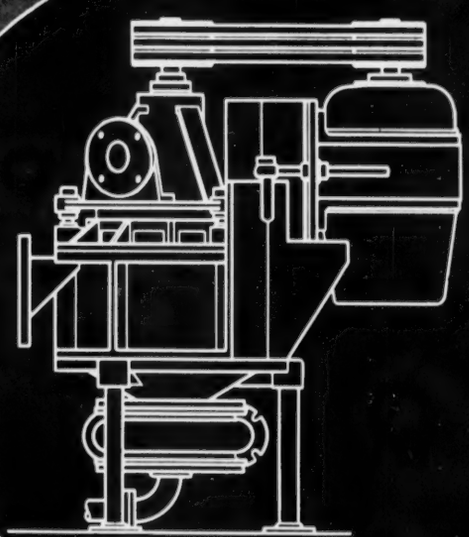

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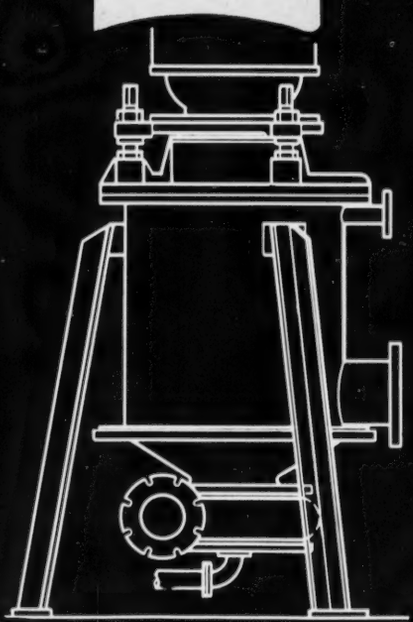

R. G.

February—the month set apart in the calendar for *E. & M. J.'s* Annual Review, the second month of the year, has been chosen expressly for this survey of the course of events and progress in 1941. Long regarded by readers as the *Journal's* most useful number, this issue serves as a work of reference for the rest of the twelve months. Its contents, as planned, include: (1) Performance of the metals and the metal markets, with tables of prices, daily, and average monthly and annual. More attention than usual will be paid to the metals of strategic importance. (2) Operations in the various districts at home and abroad. (3) Summaries of the advance scored in the technological fields of mining, milling, and smelting and their different subdivisions. There will also be the customary news of the month. Accompanying the issue as a supplement will be the new 28x40-in. wall chart of *E. & M. J.* Metal Prices and Production Statistics. Those wanting additional copies of this outstanding special number should order them as early as possible. The price will be $1, including the chart.

▼

Iron mining on the Menominee Range in the Michigan Iron Country is an activity there that is already two generations old, and this part of the Lake Superior region is still producing. A picture of current operations is presented in tabular data and photographs on pages 52 to 55, following. Among the mines included is the recently opened Sherwood, operated near Iron River by Inland Steel Co. Completion of Sherwood's new shaft to 1,286 ft. late in December has been announced and drifting to the orebody is already under way. The event was celebrated by the miners at an underground Christmas party just before the holiday. The new shaft, together with the surface plant, which has various unique features of design, will be described in an article some time this spring by R. D. Satterley, general superintendent.

H. C. PARMELEE
Editor

ENGINEERING AND MINING JOURNAL

H. W. CLARKE
Vice-President

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COVER ILLUSTRATION: Stope and pillars in a mine of St. Joseph Lead Co., Southeast Missouri

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ENGINEERING AND MINING JOURNAL

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Volume 143 JANUARY 1942 Number 1

Let's Win the War!

HISTORY probably will record Japan's assault on Pearl Harbor as the greatest blunder in the grand strategy of the war. It unified the sentiment, toughened the fiber, and roused the fighting spirit of the United States as nothing else could have done. Public and private reaction to the treacherous attack was electrical and gave the American people the will and determination to wipe totalitarian ideologies off the face of the earth. Now that the first flush of indignation and anger is over, every element of our national life has an opportunity to show how unanimously and unselfishly we can unite for victory.

We had better unite—make no mistake about that. This is no time to seek the selfish interest of any class or group. We have a foe worthy of our steel, one that is several years ahead of us in preparation for war, and one whose resources are not to be despised. Victory will be won only by mobilizing industrial America for war, and adjourning special interests—political, social and economic—for the duration of the conflict.

The Job to Be Done

MOBILIZING industrial America for war is not much more than a phrase today. Tomorrow it will be a jolting reality. Our vaunted standard of living will go by the board, temporarily but no less really. Industrial organizations will be disrupted. Civilian desires will be sacrificed to military needs. Normal industrial production for civilian use will be restricted, and the output of whole industries will be concentrated in one or two plants. The remaining units will be converted to production for war, or closed for lack of raw materials. The goal will be not how many but how few civilian needs can be supplied and still maintain morale. This is not a happy prospect, but one that will bring home to us the grim reality that the people of England and Europe have had to face for years. We must tighten our belts and face it too.

Metal Mining—No. 1 Industry

THE ROLE of the mining industry in this job is clear—to out-produce the enemy in ferrous and non-ferrous metals for ships, tanks, planes, and other implements of mechanized warfare. One striking difference between this war and the previous one is the greater amount of metal now needed per man in the armed forces. In the first World War the United States was called upon for large quantities of steel, copper, lead, zinc, tungsten, and other metals, but there was no cry of shortage. Now the chief concern of the procurement and production agencies of the Government is the critical lack of enough metal to meet military and civilian needs.

In the order of their disproportionate supply to demand, the principal metals line up thus: magnesium, aluminum, nickel, copper, zinc, lead, and iron and steel. Extensive programs are under way for increased production of the first two, but only small percentage increases can be looked for in the others. The obvious obligation of the mining industry in this shortage of metals is to adopt every means of increasing production. No single program will fit the entire industry, but the goal should be continuous operation up to the limit of labor supply, equipment and materials, and general working conditions. The United States and Great Britain control the principal mineral resources of the world, and between them they can produce the metal which, turned into war machines, can overwhelm the enemy. As leaders of war's No. 1 Industry, therefore, it is incumbent on mining operators to produce metals to the utmost. The greater and quicker the production, the shorter the war.

Labor's Part

NO ELEMENT of our people has a greater stake in victory than labor, nor can any group contribute more vitally to the success or failure of our arms. Before Pearl Harbor there was a disposition on the part of some labor leaders to take advantage of the nation's emergency to get concessions as the price of industrial peace. Witness John L. Lewis, who stubbornly defied the Government, yielding only when offered arbitration, the outcome of which

was a foregone conclusion. We want no more Lewis incidents during the war.

Labor disputes will be inevitable, but they should be restricted to *bona fide* grievances of workers who are being denied their rights, and should not arise over the closed shop or other basic labor policy. Despite the fact that the President's conference of twenty-six representatives of labor, industry, and the Government could not agree on the point, public sentiment favored the contention that disputes involving the closed shop ought not to be brought before any war labor board the President might appoint. And the people will have little patience with labor leaders who precipitate such disputes in the hour of national peril.

The union of Mine, Mill and Smelter Workers (CIO) has put forward a program for increased metal production, outlined in our Washington news. The statement contains much that is wise and acceptable, and probably will be approved by mining companies as far as the program is applicable to their properties. But the list also contains some items which, if insisted upon as necessary to the acceptance of the whole, will not only not increase metal production but will actually tend to decrease it. The sincerity of the union's suggestions will be determined by the extent to which it demands advantages that are not directly related to increased metal output.

Government's Responsibility

THE CONDUCT OF THE WAR is in the hands of the Administration. It must stand or fall, be praised or blamed, according to the wisdom or folly of its acts. In the past the President has shown reluctance to take counsel from business men and industrialists on matters in which they are expert and experienced. As a consequence his civilian organization for defense and war has floundered without a single head, and the military department has struggled with problems of production for which it is ill fitted. It is still not too late for the President to appoint a war industries board with a single responsible head, and organize a ministry of supply that will take responsibility for producing matériel for our armed forces. The steps are so obvious as scarcely to need mention, and yet they are not taken. The country understands that this is no time for "business as usual," but much that goes on in Washington is still tinged with "reform as usual." Such things should be adjourned for the duration.

Industrial Conservation

WAR IS A WASTEFUL BUSINESS. One important aspect of victory is to avoid non-essential uses of metals and to recover scrap from essential uses. The Government is keenly alive to its own obligations and opportunities in this matter of avoiding waste, and is trying to educate industry to cooperate in a vast program of conservation of war materials. Typical of what can be done by organized effort is the steady flow of light alloy scrap from airplane factories after well-organized plans were put into effect.

Mining companies and equipment manufacturers are urged to organize salvage plans for the recovery of all kinds of waste materials. Emphasis should be put on segregation of different kinds of waste. Valuable alloy steel scrap, for example, should not be consigned to the ordinary scrap pile of cast iron. Intelligently handled, junk can be converted into a variety of useful materials. But this will not be done unless someone in each organization is charged with the responsibility of initiating a plan and making it work.

Everybody's Business

THIS WAR is going to demand so much from each of us, and offer so many opportunities for service, that only the insignificant and obscure will escape participation of some kind. Fortunately the mining industry is in the front rank of essential industries, and those engaged in metal production will contribute directly to the ultimate victory. But billions of dollars will also be needed, and a part of the weekly income ought to go into war savings stamps and bonds. Only through the united effort of all our people shall we prevail against those who have been shortsighted enough to rouse us into action. Let's pull together and win the war—and quickly.

HISTORICAL SUMMARY: ENGINEERING AND MINING JOURNAL was founded in 1866 as the *American Journal of Mining*, the title being changed in 1869. Publications with which *Engineering and Mining Journal* has been consolidated comprise: *Coal and Iron Record* (1875); *The Mining Review* (1877); *The Polytechnic Review* (1879); *Mining and Metallurgy* (1902); *The Mining Magazine* (1906); *Mining and Engineering World* (1917); *Mining and Scientific Press* (1922); *Engineering and Mining World* (1932). All rights to the foregoing titles of consolidated publications are reserved by the publisher. . . . . THE FOLLOWING have served as editors in chief of *Engineering and Mining Journal* and its predecessor publications: G. F. Dawson (1866–67); R. W. Raymond (1867–74); R. W. Raymond and R. P. Rothwell (1874–89); R. P. Rothwell (1890–1901); D. T. Day (1901–02); T. A. Rickard (1903–05); W. R. Ingalls (1905–19); J. E. Spurr (1919–27); A. W. Allen (1927–33); H. C. Parmelee (1933—) . . . . THE EDITORIAL STAFF of *Engineering and Mining Journal* comprises: H. C. Parmelee, editor; A. H. Hubbell, H. C. Chellson, associate editors; J. H. Edwards, electrical editor; W. N. P. Reed, J. B. Huttl, assistant editors; H. H. Wanders, market editor; G. J. Young, consulting editor.

Reflections from Washington

By Special Correspondent

SERIOUS CROWDING in Washington, both in office space and housing, has occasioned a drastic program of moving Federal bureaus. Twelve agencies, including the Patent Office, S.E.C., and the Wage-Hour Division, have been ordered to move. The three named are expected to return to Washington after the war; the others will stay at their new stations. The Budget Bureau continues to search for other bureaus which can be removed from the Capital City. Altogether 20,000 or more government workers will be affected. This means that between 50,000 and 100,000 persons will have to change their jobs or move away from the Capital. Mining executives and engineers having dealings with these bureaus may continue to address them in Washington until formal notice of change is issued. However, when conferences are required after mid-January, it will be desirable to determine in advance whether the bureau to be consulted is still in Washington.

Preference Rating for Smelters and Refiners

PREFERENCE RATING ORDER P-73 was signed in December, providing priority ratings for repair, maintenance, and operation of smelters and refiners of copper, lead, zinc, antimony, mercury, or cobalt. Persons desiring to obtain the benefit of P-73 will be assigned serial numbers for their smelting and refining plants after filling out a form PD-212. Like the preference rating order P-56, on mining machinery, the new order will be administered by Dr. Wilbur Nelson, administrator of mining priorities, Washington, D. C.

The following preference ratings have been assigned: A basic rating of A-3 for delivery of general materials for repair, maintenance, and operation, with special ratings of A-1-a in case of breakdown or suspension of operations, and A-1-c for advance provision to avert breakdowns and suspensions.

Metal Saving

ECONOMY in use of metals is no less important than speed of production. Hence OPM has organized and several times reorganized and expanded a definite unit to care for these matters. Even the producer of metals can make his production effort most effective by noting certain facts regarding this set-up, which is known as the Bureau of Industrial Conservation.

There are four branches of this bureau, all working under the chief, Lessing Rosenwald, and deputy chief Paul C. Cabot. The branches deal with salvage, simplification, specifications, and conservation and substitution. Numerous new specifications have been formulated to accomplish changes in metal requirement. Some of these take the form of substitution of relatively abundant metal for scarce (there is no such thing as an abundant metal). The division of specifications operates under C. L. Warwick.

Simplification of types and varieties of products is also contributing as a variation of the specification problem. The simplification branch works under E. W. Ely, assigned to this project from the commercial standards division of the Bureau of Standards. By reducing the types of any commodity which are available for general distribution the stocks which have to be carried by wholesalers, retailers, and consumers can be made smaller. Thus, even when the ultimate consumer uses the same number of units of a "simplified" commodity, the metal requirements are less.

The conservation and substitution branch works under H. A. Anderson. It deals with the multitude of methods by which the mining industry's customers can reduce their drain on the metal supply. This effort applies to Army, Navy, and Marine consumption, as well as to civilian usage.

The salvage branch works both with metal-using establishments and with primary- and secondary-metal producers. The building up of a more adequate and rigid system of scrap collection and classification is assisting materially. George T. Weymouth heads the industrial section of this branch. His organization is sending inspectors out into industry to assist management in the proper organization of salvage plans. They report the reclaiming of over two million pounds per month of light alloy scrap in a single campaign at plants that thought they were doing a good job before the inspectors got there. Every unit of the mining and metal processing industries is urged to use extreme diligence, as a ton of metal saved is just as useful as a ton of new metal produced.

Probable War Effects

PREDICTION as to the exact effect on mining and mineral industries of actual war effort is difficult. It appears, however, that the following influences and prospects can safely be assumed as likely to govern in 1942:

1. More men will be taken for the Army. Those already in will stay for the duration. Employment of women will be encouraged.

2. Frequent and sudden suspension of marketing of important commodities will be imposed. Note the stoppage of the sale of automobile tires within the first week of the war.

3. The shift from priorities to direct allocation of commodities will occur soon for all very scarce materials.

4. Every factor that may contribute to increased speed of production will be demanded. Increasing the number of shifts per week is but one such example. Any other factor, even if it imposes increase in costs, will be urged—perhaps required.

5. Submarginal producers of metals or scarce minerals will be encouraged to start operations. Some kind of subsidy will be provided, but action and not negotiation will be demanded meantime.

6. A rise in costs is expected. Some comparable increases in price will be permitted generally. But price ceilings will be held as rigidly as possible. Some of the increases in costs will have to come out of earnings.

7. New and very severe taxes will be imposed, sooner because of the war. Some sort of withholding tax on wages, salaries, and commissions may be expected.

8. Thought will be given to post-war factors; but any post-war consideration that interferes with war-time production will not be allowed to enter significantly in the planning.

Labor Program

IN PRESENTING ITS PROPOSAL for continuous operation of copper, zinc, and lead mines, the war production committee of the International Union of Mine, Mill, and Smelter Workers (C.I.O.) outlined the following major points:

"1. Seven-day, three-shift operations.

"2. Improved ventilation.

"3. Abolition or modification of the contract system of wage payments.

"4. More efficient 'servicing' of miners with tools, haulage, and hoisting facilities

"5. 'Up-grading' of skills, greater specialization of tasks, training of new miners on the job, and a complete survey of the available mining labor supply.

"6. Increases in wage rates where necessary to attract workers from less hazardous and less essential occupations.

"7. Provisions of adequate housing in mining camps.

"8. The establishment of local union-management production committees to work out at each mine, mill, smelter, refinery, and primary fabricating plant the details of wage adjustments, labor management, working conditions, and the handling of grievances.

"9. Provision by the OPM of engineering and other consultants to assist local production committees in expanding nonferrous metals production.

"10. The establishment of a national industry-wide committee of Government, industry, and labor officials to coordinate the work of the local committees, make over-all surveys of production capacity, and study the possibilities of bringing idle mine capacity into operation."

Blackout Plans

WASHINGTON confidently expects at least "token" bombings of important cities. Naturally great military centers and the important seacoast cities like New York, Washington, San Francisco, and Los Angeles are most likely to be attacked. Preparation for civilian defense, including protection of industrial property, is primarily the job of Office of Civilian Defense.

If sabotage of any sort is suspected, steps are to be taken through the Federal

Bureau of Investigations of the Department of Justice. That agency deals with all alien questions and all matters of actual or suspected interference with the war effort. Those requiring either advice or active cooperation should communicate either with the nearest F.B.I. office, or with the Washington headquarters.

Local organization to care for all matters of civilian protection, including protection of property from enemy attack, is expected to be cared for by the individual communities. Thus, mine managements in isolated areas will be expected to manage their own affairs of this kind. They can, however, get information, some equipment, and at least nominal support from both O.C.D. and F.B.I.

New War Plans

SOME NEW LINES of authority for war programs seem certain, although the form in which the authority will be organized is not clear. Even the President apparently has not set up the complete program in his own mind. It is useful, however, to forecast certain rather obvious and necessary types of coordination.

Inter-allied war plans will have to be organized to determine, above all other activities, the military policy and strategy. The magnitude of military need will be determined primarily by Army and Navy cooperation, presumably through the joint Munitions Board. Civilian supply (and price problems) will be handled through an agency comparable with the old OPACS, and likely under Leon Henderson. World trade, including Lend-Lease, will be managed by some economic warfare board which at present is SPAB, headed by Vice President Wallace and managed by Donald Nelson.

Only after these three functions of military supply, civilian supply, and economic warfare are fixed does the actual job of production begin. That job continues under OPM, with attention to raw materials, manufacture, conservation, and the related and interlocking problems. The mining industry will largely take its orders from OPM as now constituted or from its successor of whatever name, form, and personnel. It is evident from all this that many of the plans made by OPM cannot be regarded as originating within that agency. They are formulated by the agency only after it has received policy instructions from one or two levels higher up. The decisions of OPM are, none-the-less, compelling when issued.

More Copper Demanded

EVEN the most optimistic forecasts of copper production are too small to satisfy Washington. Hence a 21-shift week is going to be demanded in this industry above all others. Early estimates, partly official, partly unofficial, seem to add up to an increase of 200,000 to 300,000 tons per year greater output from going mines through this long-work-week program. All influence is still being put behind other plans for every type of increased output.

The proposed OPM copper production hearings scheduled for Dec. 18 did not materialize. But Chester Davis, who was scheduled to be presiding officer, has been asked to carry on by correspondence the investigation regarding possible further stimulation of output. Instead of the production conference a labor conference was held on Dec. 18. No official interpretation has been issued, but it is evident that OPM leader Sidney Hillman was pleased with the sincere spirit of cooperation between management and labor that developed.

At the labor conference price questions were mentioned; and much confusion resulted from erroneous subsequent public statements. The fact is that OPA has not changed its policy regarding copper price. Administrator Henderson clearly states that 12c. is believed to be adequate for all ordinary production. He does recognize the need of a special "bonus" price for high-cost producers who cannot carry on at the normal 12c. level. He intends to continue the policy of granting such special consideration in the future as in the past. Prices up to 18c. are talked for special circumstances. But no general application of high prices is expected under any present forecastable circumstances.

News "Fines"

Lead for Gasoline—Makers of ethyl fluid for anti-knock gasoline have been struggling with the problem of metal supply. They have offered to pay any special price necessary or even to buy some inefficient little lead mine in order to insure continued operation. Without supplies beyond those available to them early in December they feel that they will fall far short of the requirement, which is something more than 100,000,000 lb. per year of metal for military and civilian supplies combined.

Mine Inspection—During December the Bureau of Mines began its first official inspections of coal mines under the new mine safety legislation enacted by Congress during the summer. Experienced mining engineers are being trained as inspectors at the Pittsburgh station of the Bureau. Under the law there will be no comparable inspections of metal or non-metal mineral mines. Mining engineers of these industries may, however, secure advice and assistance regarding inspection practice from the Bureau staff, if desired.

Freight-Rate Rise—It is expected that freight rates will be advanced with the approval of I.C.C. so that the railroads of the country may get greater income to compensate them for approximately $300,000,000 in increased wages required by the strike settlement reached in November. Generally speaking, freight-rate increases requested amount to 10 percent of the old charge.

Explosives Licenses—A full program for licensing producers, marketers, and users of explosives was undertaken promptly after declaration of war. The old authority of the President was adequate for this even if a new law had not been under consideration lately by Congress. It is expected that each individual responsible for issuing explosives will have to have a license as soon as the program is fully organized. Miners working under licensed supervision will probably not be individually licensed.

Explosives Priority—Shortage of industrial explosives is threatened. The OPM, therefore, has granted an A-8 rating to manufacturers so that they may secure the necessary stocks of material for regular production and packaging. Included are all manufacturers of all types of blasting powders, dynamite, and other common mining explosives.

Labor Accord—The labor-industry conference meeting before Christmas agreed on several major points for elimination of strikes. Officially the proceedings were complimented by the President. But this has not stopped sharp criticism about the Capitol. Critics say, among other things, "On the only controversial issue, the closed shop, there was no voluntary agreement." Also, other observers express frankly the fear that the jurisdictional issue has not been settled, and probably will not be as long as A.F. of L. and C.I.O. retain their separate activities and present hard feeling one for the other. Despite criticism it is expected that patriotism will prevent most labor-dispute interference with production. If there are strikes, however, Congress is likely to complete action on the very drastic anti-strike bill which passed the House of Representatives early in December.

Natural Sodas—Washington has begun to worry about the supply of soda ash for glass-making. Shortage of tin will greatly increase glass container demands. And the makers of chemicals are not likely easily to keep up with the raw-material problem. It is anticipated, therefore, that any mining firm which can open up promptly even submarginal supplies of natural sodium compounds may be encouraged to do this. Before any expenditure is undertaken, however, it is suggested that preliminary arrangement be made both with prospective customers and with price authorities permitting charging of higher than normal prices which may be necessary for the development of such high-cost properties on a temporary basis.

Engineer Shortage—Multiplication of defense production is developing a serious shortage of supervisory personnel, engineers, chemists, and research workers. To supply some of this need, the Office of Education, working with all universities and technical schools, is financing special courses and arranging for a speed-up in the educational process generally. Mining companies needing cooperation in the specialized training of such personnel can arrange to have needed courses given at any accredited engineering school, with the government paying most of the bill. Shortage of highly skilled personnel requiring training below college grade can be arranged for through the training branch of OPM where vocational courses are organized.

Tin Plants—War in the Pacific, of course, means more to tin supply than to any other metal of large importance in the United States. Therefore, OPM took prompt steps in mid-December to restrict all further use of that metal. Complete rules of allocation have been announced for users. Control of all imports is now with the Government. Just before war declaration, SPAB had allocated over 200,000 metric tons of tinplate for Latin American use. It is not expected at the end of December that this allocation will be withdrawn. Hemisphere cooperation is too important to deprive the Latins of tin plate.

The plant, at Freeport, Texas, where The Dow Chemical Co. recovers magnesium from sea water. Since it was put into commission in 1940, its capacity has been doubled and now orders have been received to increase it again, to more than double its new output, in 1942

Magnesium for VICTORY

An editorial summary of processes and plants designed to produce the light metal at the rate of 200,000 tons annually

► EDITOR'S NOTE—*The information presented herewith has been obtained from a number of sources, chiefly "Chemical and Metallurgical Engineering," engineers of The Dorr Company, and H. A. Doerner, metallurgist of the Bureau of Mines, who presented the subject at the San Francisco meeting of the American Mining Congress last October.*

BUT for the extraordinary demands of the defense program in 1941-42 magnesium probably would not have gained the spotlight of interest it now occupies. The metal was used in military pyrotechnics during the first World War, at the close of which five American companies were in production. Most of them went out of business when the government's war requirements ceased, and only Dow Chemical Co. continued to recover the metal from brine at Midland, Mich.

Contrast those conditions with the prevailing situation. As much as 1,000 lb. of magnesium may enter into the manufacture of a single airplane. And when one considers that the United States is scheduled to turn out 4,000 planes a month in 1942, it is evident that magnesium is no longer a minor metal. In addition to the requirements for planes are the almost limitless quantities needed for incendiary bombs and pyrotechnics.

Despite its unique properties the present widespread use of magnesium as a structural material developed only very slowly in this country. In fact it was not until 1938 that our Army Air Corps felt that magnesium alloys had sufficient corrosion resistance to warrant their use in airplanes. Then came the second World War and our policy of being an arsenal for the democracies. This has brought on a breathtaking expansion in the magnesium industry. From one small plant producing less than 7,000,000 lb. in 1939 we are now building eight plants, at a cost of $240,000,000, which together with the Dow plant at Midland, Mich., will give this country a total capacity of 400,000,000 lb. of metal annually.

Table I gives a summary of information on magnesium production in the United States, including plants under construction and to be built, as well as those now in production.

Dow Chemical Co. is the largest factor in the business, with its original, enlarged, plant at Midland, Mich., and two plants at Freeport, Tex., one in production and being enlarged, and the other to be built.

Magnesium from Sea Water

The Dow process for recovering magnesium from sea water ranks as one of the outstanding achievements in chemical engineering, and parallels the same company's process for recovering bromine from ocean waters. Magnesium exists in sea water to the extent of only 0.13 percent, so that a nice engineering problem is presented in designing and operating a plant to recover one ton of the pure metal from 800 tons of raw material.

The plant site is a 2,000-acre peninsula in the harbor of Freeport, Tex., where a diversion of the Brazos River to a new channel offered many natural advantages.

Some years ago the Brazos River had been dammed several miles upstream and the river water diverted into a coastal canal, allowing ocean water to back up into the old mouth of the river. So Dow did not have to construct an expensive intake system out into the ocean; the company simply pulls water out of what was once the mouth of the Brazos River. When the spent water passes through the plant, it is put into the coastal canal and returned to the ocean miles away, where it cannot dilute incoming water.

300,000,000 Gallons Daily

About 300,000,000 gal. per day of sea water is drawn into the plant by Worthington centrifugal pumps each of 71,000 g.p.m. capacity and driven by a 500-hp. direct-connected induction motor. After being cleaned of trash and refuse by Link-Belt and other screens, the raw material—sea water—is ready for treatment.

The other raw material used in the process is oyster shells. These are dredged from the bottom of Galveston Bay, washed, and calcined in a 300-ft. rotary Trayton kiln which is direct-connected with the lime slaker. Slaked lime flows to a 150-ft. Dorr thickener, which serves the double purpose of storage, and thickening the milk of lime. The overflow goes back to the lime slaker and the thickened underflow goes to the floceulator, where it is mixed with sea water. Magnesium hydroxide is precipitated.

The magnesium hydroxide floc suspended in sea water is then ditributed to four 200-ft. Dorr thickeners, the clean overflow of which goes to the pump basin and ultimately to the

waste-water canal. The heavy "milk-of-magnesia" underflow from the thickeners is picked up by Dorreo sludge pumps and carried to the storage or retention tanks ahead of the filters. Huge Moore filters of a type once widely used in Western metallurgical plants have been redesigned to accomplish this operation. Fully 90 ft. in length, each with approximately 100 canvas-covered leaves, the filtering units are lifted, lowered, and shifted by means of a large overhead crane. First the filter unit is lowered into the rectangular concrete tank into which the magnesium slurry has been pumped. Suction is then applied until a cake 1 to 1½ in. in thickness has been built up on the leaves. Then the crane lifts the unit, carries it over, and lowers it into an adjoining compartment, where air is applied to loosen the cake. This drops off and a screw conveyor at the bottom of the tank carries it to the neutralizing unit.

Here in rubber-lined steel tanks the hydroxide meets a 10 percent hydrochloric acid solution which converts it back into the magnesium chloride required for the subsequent electrolysis. The hydrochloric acid has been made elsewhere in the plant by burning natural gas in the byproduct chlorine from the magnesium cell house, supplemented with make-up chlorine from the electrolytic caustic soda cells in an adjoining building.

Now begins the magnesium chloride concentrating and drying operations. The first step employs direct-fired evaporators. The dilute magnesium chloride solution is sprayed into the top of a cylindrical brick-lined furnace, nearly 20 ft. in diameter and 40 ft. in height. A spider distributor deflects most of the liquid down the side walls of the furnace in which natural gas is burned under pressure. The steam, along with the products of combustion, passes through another steel tower and finally into one of asphalt-impregnated wood, where baffles remove the entrained water and solution.

The concentrated magnesium chloride solution from the direct-fired evaporators is filtered through Shriver plate-and-frame filter presses to remove solids that have crystallized out in the retention tanks. The filtrate then goes to the so-called shelf-dryers, resembling Herreshoff furnaces. Each is a structure 50 ft. in diameter and at least 50 ft. high with 12 shelves onto each of which the magnesium chloride is fed from the periphery while the solid material is raked to the center of the dryer and falls to the lowest shelf. Heat is supplied by two large gas burners and large circulating fans distribute the hot gases over the material on the shelves.

The semi-dried material, from which perhaps two-thirds of the water of crystallization has been removed, receives its final drying to practically anhydrous condition in a gas-fired rotary dryer, where it is mixed with previously dried material in flakes.

The electrolytic decomposition of the dehydrated $MgCl_2$ is carried out in a rectangular cast-steel pot set in refractory brick furnaces. Each cell is about 6 ft. wide and 12 ft. long. The steel pot serves as the cathode in the electrolysis. Graphite electrodes enter the open top of the furnaces. The cell bath is maintained at approximately a constant level by either a continuous or intermittent feed of dehydrated magnesium chloride. Sodium chloride is added from time to time to reduce the melting point and increase the conductivity of the bath.

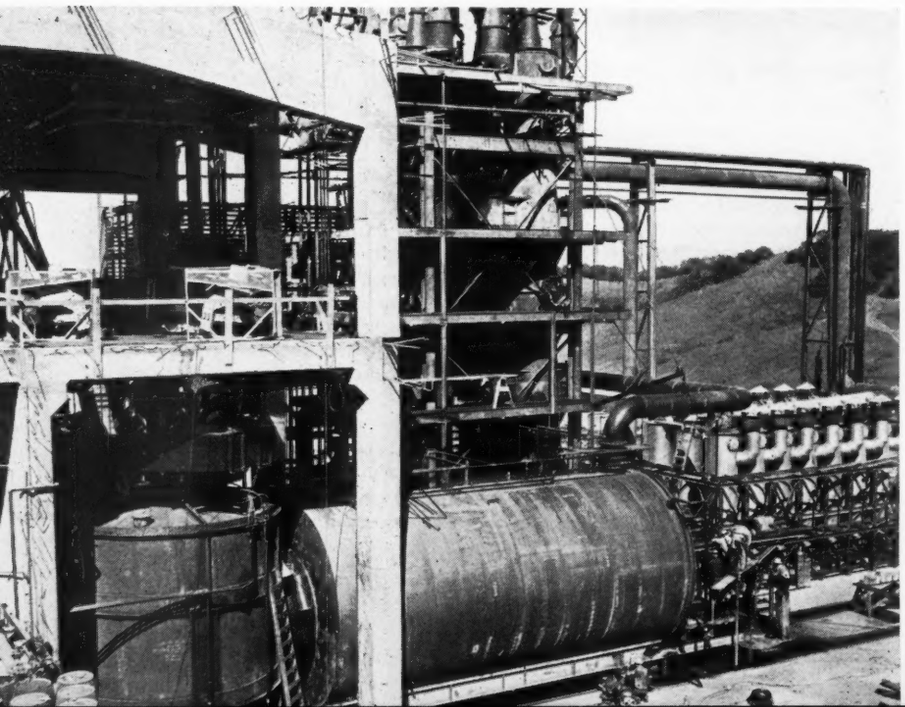
The electrolyte is kept in molten condition (670 to 730 deg. C.) by gas-fired furnaces on the first floor level beneath the pots, or they can be heated by electricity above. The normal operating voltage is six to nine volts. Power requirements for the Dow process are said to be 8 to 10 kw.-hr. per pound of magnesium. Each cell produces about 1,000 lb. of metal per day of 99.9 percent average purity. The fused metal is lighter than the cell bath and therefore rises and floats on the surface but does not burn, because of the protective action of a thin film of the molten salt bath. The fused metal is removed by hand ladles and cast into 18-lb. pigs.

Chlorine, liberated by the electrolysis, is taken up by a current of air and blown to the hydrochloric acid plant, where it meets a stream of natural gas with which it unites to form hydrochloric acid and carbon monoxide. The acid is absorbed in water to form the neutralizing acid to convert magnesium hydroxide into the chloride.

Table I—Summary of Magnesium Plants in Production and to Be Built

Plant Location	Capacity, Million lb.	Raw Material	Percent Mg	Final Step in Process
Dow, Midland, Mich.	18	Deep well brine	3.00	Electrolysis of $MgCl_2$
Dow (No. 1), Freeport, Tex.	36	Sea water	0.13	Electrolysis of $MgCl_2$
Dow (No. 2), Freeport, Tex.	72	Sea water	0.13	Electrolysis of $MgCl_2$
Permanente Corporation, Permanente, Calif.	66	Brucite or Magnesite	41.60 28.70	Electrothermal reduction of MgO
Diamond Alkali Co., Painesville, Ohio.	36	Dolomite	13.80	Electrolysis of $MgCl_2$
Mathieson Alkali Works, Lake Charles La.	36	Dolomite	13.80	Electrolysis of $MgCl_2$
Union Potash & Chem. Co., Austin, Tex.	24	Magnesium chloride	25.00	Electrolysis of $MgCl_2$
Basic Magnesium, Inc., Three plants in Nevada.	112	Magnesite	28.70	Electrolysis of $MgCl_2$

Part of the magnesium plant of the Permanente Metals Corporation, at Permanente, Calif., as it appeared last July before completion. At the left is the reduction furnace and chilling cone. To the right of the furnace are the condenser cooler, the agglomerators, and bag filters



Hansgirg Process

The plant of the Permanente Corporation in California is the fourth to use the process of Dr. Fritz Hansgirg. The first was in Austria, the second in Wales, and the third in Korea. Production at Permanente began last August using brucite or magnesite as raw material. Briefly, the process consists in calcining brucite, $Mg(OH)_2$, or magnesite, $Mg(CO_3)_2$, briquetting the calcine with pitch and reducing the mixture in an electric furnace.

Briquets are fed continuously into a wholly inclosed, carbon-brick lined, 3-phase electric arc furnace—one of 8,000 kva. and others of 12,000 kva. capacity—operating at a temperature of about 2,100 deg. C. The reaction proceeds according to the equation

$$MgO + C = Mg + CO$$

The reaction temperature being more than 1,000 deg. C. above the boiling point of metallic magnesium, the metal leaves the reaction as vapor mixed with an equal volume of carbon monoxide and must be chilled quickly below 200 deg. C. to prevent the reversibility of the reaction.

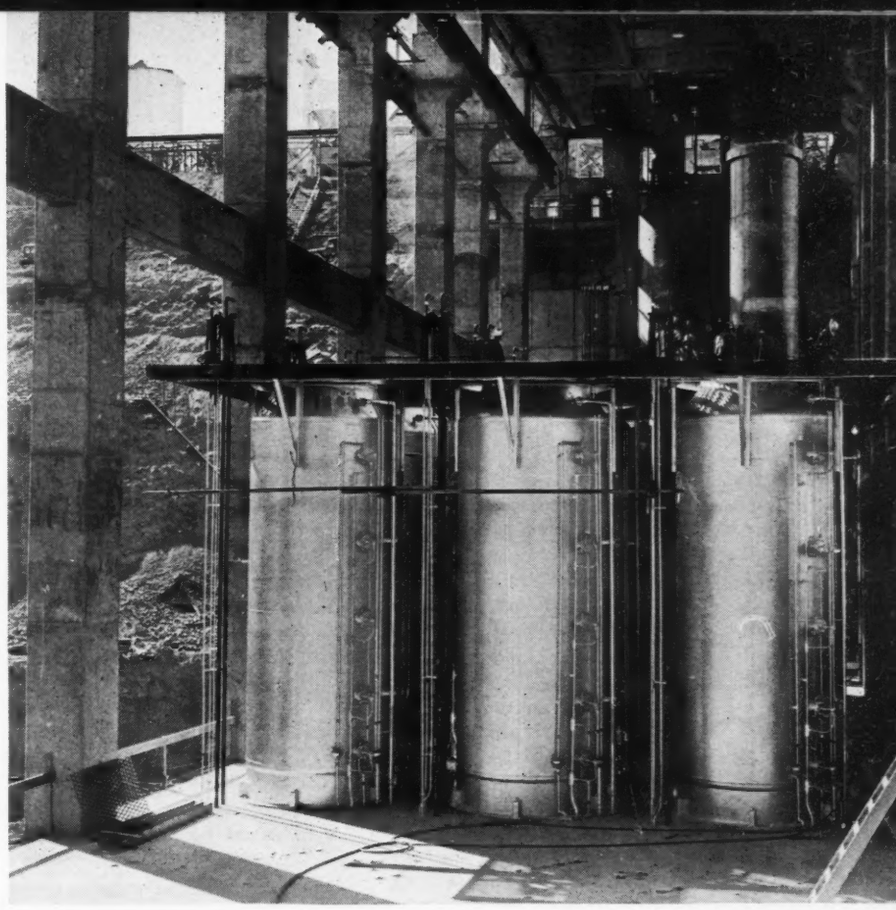
The reaction products from the furnace are drawn off through a specially designed stainless-steel nozzle and condenser. They are immediately chilled by the blast of natural gas injected through the condenser at the rate of approximately 25 volumes of natural gas to each volume of furnace gases. After this initial quenching the magnesium, along with certain impurities, is carried as fine dust into the cooling chamber—a large cylindrical drum equipped with revolving scrapers to prevent caking on the side walls and with a reaming mechanism to prevent any plugging of the furnace nozzle. As the velocity is reduced, some of the magnesium powder drops to the bottom of the condenser and is caught by a screw conveyor that takes it to a dust storage bin.

In the meantime the temperature of the gas has been lowered to about 150 to 200 deg. C. and most of the dust is carried by the cooling gases to an electric "agglomerator." This is an electrostatic precipitator that serves to increase the particle size of the magnesium dust. The remainder of the dust is removed in woolen bag filters and that portion of the gas which is not recirculated (approximately 25 percent) is withdrawn for fuel use in the cement mill.

Dust Is Mixed With Oil

The dust from this primary reduction consists of 60 to 65 percent metallic magnesium, contaminated with some MgO and carbon carried over from the furnace. Before it can be purified by redistillation the dust is mixed with hydrocarbon oils to make a paste, which is charged directly to the retorts, where the oil is distilled off. The temperature is then raised and the magnesium distilled. Special gas-fired furnaces are used to remove the hydrocarbons. The totally inclosed, electrically heated retorts operate at temperatures of about 750 deg. C. and under extremely high vacuum. These retorts, which are operated on a batch basis, will each hold sufficient paste to yield slightly more than a ton of metallic magnesium every 72 hours.

The vaporized metal rises to the upper part of the retort and is deposited there on the water-and-air-cooled steel walls of a removable shell. After the distillation is completed, the top of the retort furnace is removed and an overhead crane lifts out the upper shell, on which the metallic magnesium has condensed into a crystal ring shaped like a hugh doughnut. This is dumped on the ground floor of the adjoining cooling room and transported from there to the conventional foundry furnaces for remelting and casting into the form of pigs and ingots. The metal in this form is understood to have a purity of about 99.97 percent.



Some of the retort furnaces in the Permanente magnesium plant

The estimated power consumption for the Hansgirg process per pound of magnesium is as follows:

	Kw-h.
Reduction furnace	6.6
Distillation	1.1
Remelting	0.2
Auxiliaries	0.2
Total	8.1

The three plants of Basic Magnesium, Inc., in Nevada will use the English-German I.G. process known as the Magnesium Electron, Ltd., or M.E.L. process. Magnesite will be calcined and then chlorinated by heating with carbon and chlorine to produce anhydrous magnesium chloride, which will be electrolyzed. It is reported that for the chlorination operation a resistance furnace is used in the form of a tower having a vertical electrode extending down through the roof and another at the base embedded in a bed of crushed carbon. The tower is charged with a mixture of calcined magnesite and coke, chlorine is run in at the base, and the carbonate is converted to chloride, which is tapped in the fused condition and fed to the electrolytic cells. Temperature is maintained at 700 to 900 deg. C., and the mixed gases escape at the top. The chlorine is derived from the electrolytic bath in the reduction process and from chlorine caustic cells. The cell will probably serve the combined purpose of dehydrating the magnesium chloride and electrolyzing the anhydrous chloride.

At Carlsbad, N. M., the International Minerals & Chemical Corp. has been working on the utilization of a magnesium chloride byproduct as a source of metallic magnesium. Langbeinite (double sulphate of potassium and magnesium) and sylvite (potassium chloride) are reacted in solution for the production of potassium sulphate. In this so-called base-exchange reaction, the potassium chloride and the sulphate of potash-magnesia will react to yield potassium sulphate and magnesium chloride. The latter, in approximately 18 percent solution, is now sent to waste, but will be further concentrated and dehydrated, and shipped to Austin, Tex. There the company is building a plant in which the anhydrous magnesium chloride will be reduced to the metal in Dow cells.

The magnesium plants that are to be operated in conjunction with the ammonia soda plants of Mathieson Alkali Works and Diamond Alkali Co. are based on the use of dolomite and calcium chloride that has been a waste product from the alkali plant. Dolomite is calcined. The magnesium and calcium oxides are treated with calcium chloride to convert the magnesium to the chloride. This mass is then treated with carbon dioxide gas from the calcining operations to convert all calcium to the carbonate. This is removed by filtration, leaving the magnesium chloride, which is concentrated. The anhydrous magnesium chloride is then electrolyzed in Dow cells.

Potash Company of America . . .

II—In its treatment plant the soluble salt is

R. A. Pierce
Assistant General Manager

▶ THE DEVELOPMENT *and mining of sylvite potash ores by the company in the Carlsbad district, New Mexico, was dealt with by Messrs. Pierce and Anderson in the December issue. In the present and concluding installment, the treatment plant, or "refinery," which is located at the mine, is described by the authors.*

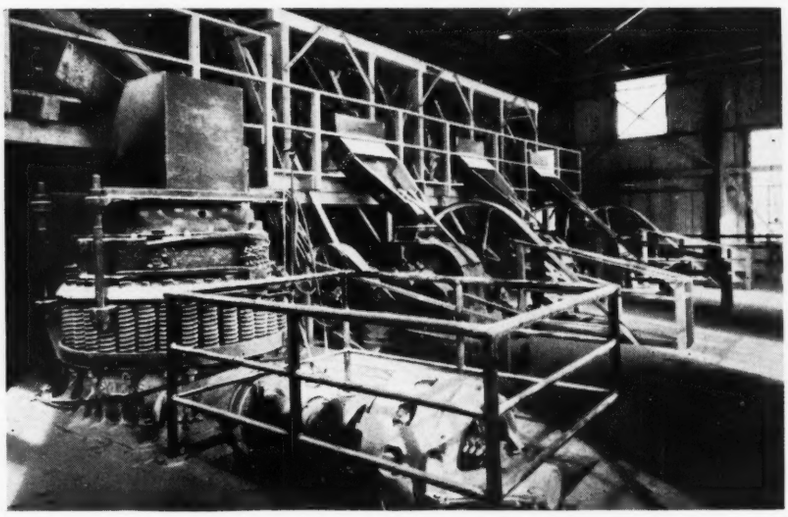
ORE BROKEN underground to pass about 5- or 6-in. ring is transferred by belt conveyor from the mine-shaft bin to the crushing plant. This was built about a year and a half in advance of the main plant, known locally as the "refinery." Its construction is simple, including a plain bar grizzly, one 48-in. Symons crusher, four 16x36-in. rolls, Jeffrey-Traylor magnetic vibrating screens preceding each of those machines, belt conveyors, and appropriate feeders. The products of crusher and rolls are collected on one 24-in. belt conveyor and conducted to a steel surge bin, from which the material is fed, over the vibrating screens, back to the rolls, which take the oversize only from the screens. The undersize through the screens, of −10 mesh, constitutes the finished product of the crushing plant, generally known as "Manure Salts." The scheme of crushing adopted was devised to produce material as uniformly granular as possible. This product of the company has been well received in the markets on account of that characteristic.

From the crushing plant the −10 mesh material is carried by belt conveyors to any one of three different places. The major part is deposited in the cylindrical conical-bottom bins providing feed to the tube mills in the refinery. By means of a deflection chute the flow of material on this conveyor line may be diverted to a similar bin beside the railroad track, from which manure salts may be loaded directly to railroad cars when called for, a Stephens-Adamson Sinden-type of box-car loader being used at this point. Another conveyor line carries manure salts, bled out of the mill circuit by special screens, to the mixing station for blending with concentrated potash to produce grades of potash lower in K_2O content than that of the refinery product. There is considerable call for potash carrying the equivalent of 50 percent K_2O, about 80 percent KCl. With the arrangement mentioned, any grade called for below that of the highly concentrated refinery product can be produced.

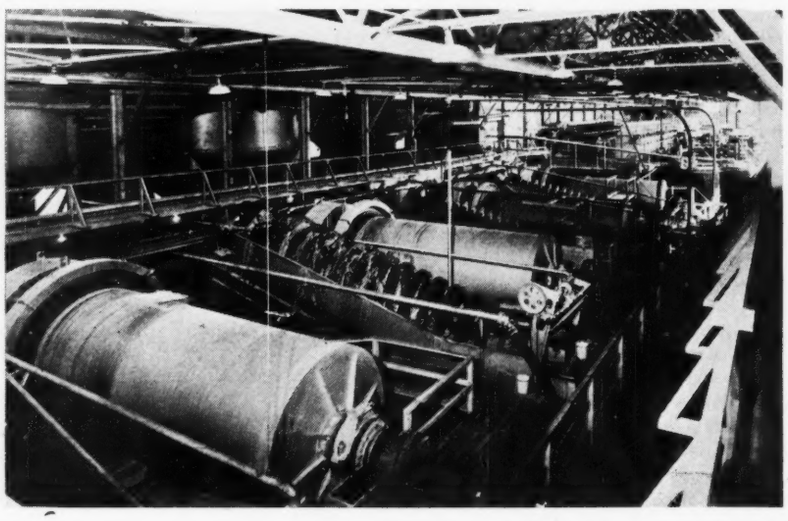
When the matter of treating the ore developed was first considered, a number of problems were immediately encountered, chief of which was that of water supply. The only water available in the vicinity was that from the mine shafts, exceedingly high in dissolved salts—too much so to permit the use of the conventional solution and crystallization process. Treatment of the water for purification would have been prohibitively expensive. Study was made, therefore, of other possibilities that suggested themselves for concentrating the potash.

The development that followed the many months of research led to the construction of the works of Potash Company of America wherein this rev-

Inside the crushing plant. Behind the crusher are three of the four sets of rolls mentioned in the accompanying text



In the treatment plant. Grinding mills and spiral classifiers in foreground, flotation machines in background at right



Producer of Sylvite at Carlsbad

concentrated by flotation in a saturated brine

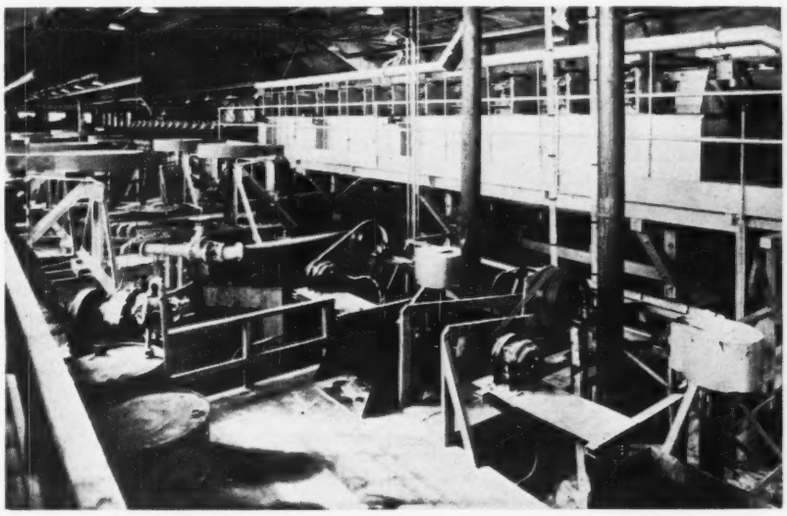
L. D. Anderson
Consulting Engineer

olutionary process for the treatment of sylvinite potash ores has been carried on successfully ever since the fall of 1935, constituting, as far as is known, the first commercial plant to concentrate a soluble salt by flotation in a saturated brine. A description of the plant follows:

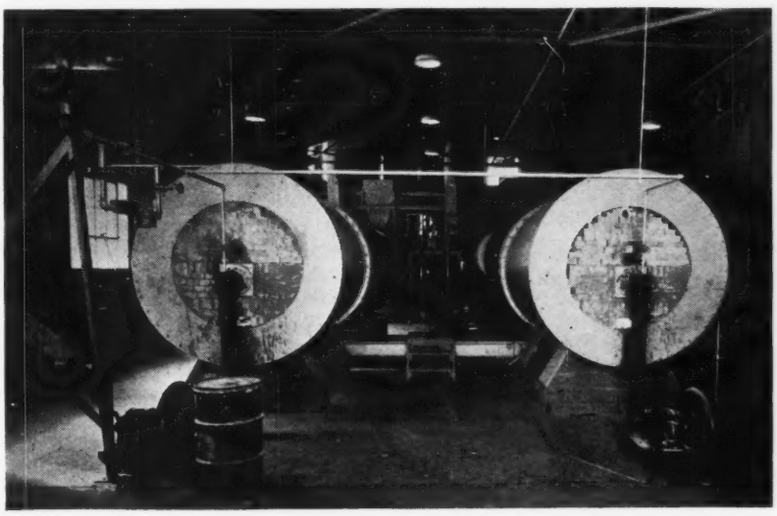
In the refinery are four tube mills with Akins classifiers in closed circuit, as the grinding units. These have recently been supplemented by the installation of a 6x6-ft. ball mill and classifier. Each of these is fed by a large pan feeder from its respective cylindrical conical-bottom bin mentioned. The classifier overflows are pumped to thickeners to produce a pulp of the right density for flotation, the thickener overflows going to join the tailings.

In the flotation section there are three units, Nos. 1, 2, and 3, so numbered in order of installation. The No. 1 unit, similar to the others except for number of cells, has ten "rougher" cells, six "middlings," or concentrate-cleaning cells, and six tailings-cleaning cells, of the M. S. subaëration type, as built by Stearns-Roger Manufacturing Co., of Denver, Colo. The rougher cells make a voluminous froth, lifting the sodium chloride and the clayey slimes by mechanical entrainment, leaving behind the potassium chloride. The first few cells of the series make a tailings low enough to discard. Progressively beyond those cells a little more potash begins to appear in the froth, so the froth from the last cells is conducted to six cells for cleaning. Underflow of these cleaner cells is returned to the circuit via the tube mill classifiers. The concentrated potash underflow of the ten rougher cells is taken to a bank of six middlings cells, more properly termed "cleaners." Underflow of these cleaner cells is high-grade potash. Their froth was formerly considered as middlings—hence the name—and treated as such. Later it was found that these middlings, for such they really are, could be advantageously taken care of in the flowsheet of the plant by running them in with the tailings.

In the refinery building. Soap tanks in foreground, heating and cooling agitators on left. At higher elevation, the flotation machines

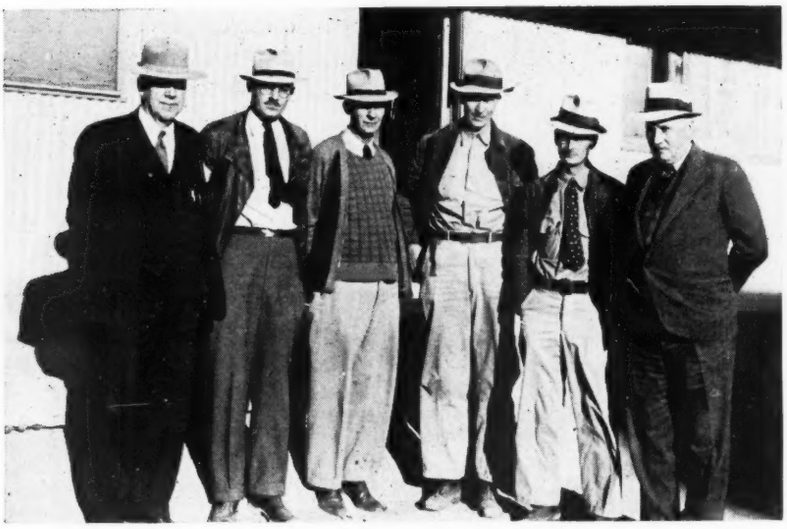


Fine concentrate, after being thickened and filtered, is conveyed to these two drum dryers. The briquetting plant is on the other side of the wall at the right

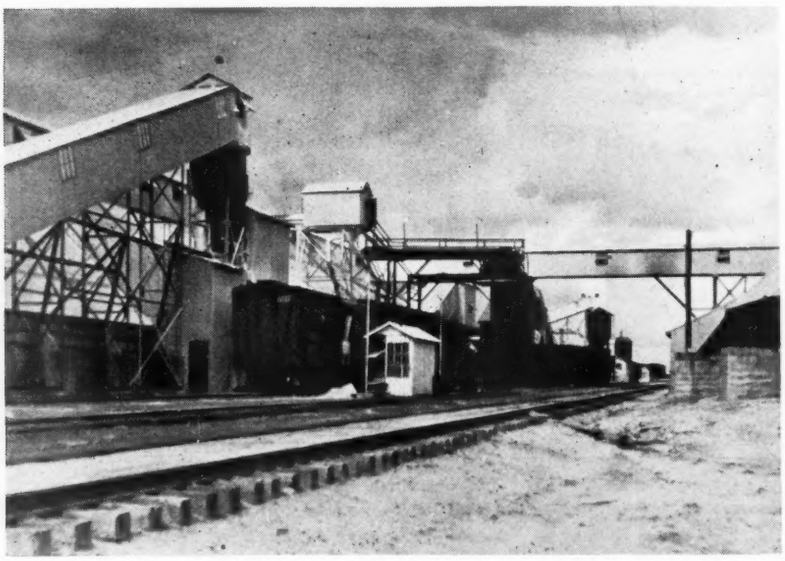


The tailings are treated in the "heat-cycle" process, before final discarding. For this process there are provided several agitator tanks, in each of which is a motor-driven marine-type agitator impeller, and three concentric sets of pipe coils through which circulates the hot water from the jackets of the diesel engines in the power house. Tailings pulp is warmed a few degrees in passing through these agitators, resulting in dissolving out the small amount of residual potash left in them from the flotation operation. The warm pulp is then thickened in two Dorr thickeners.

The thickened pulp then goes to a Moore filter, where the solids, after being washed by immersion of the filter leaves in a tank of salt brine, are discharged, repulped, and pumped to the tailings dump. The warm brine overflow of the thickeners is cooled in agitators similar to those used for the heating of tailings pulp, except that cold water from cooling towers circulates through their pipe coils, which cooling effects a crystallization in solid form of the potash which had been dissolved out of the tailings so that



Left to right, L. D. Anderson, K. F. Peters (mechanical engineer), R. A. Pierce, A. W. Kangas (mine foreman), G. C. Weaver (chief mining engineer), R. M. Magraw (general manager)



The loading "docks," where the refinery products are loaded for shipment

Another view of the plant. No. 2 granular storehouse on left and No. 1 storehouse on right. Between the headframe and the thickener is the briquetting plant

it may be recovered in subsequent filtration.

Although based on the principles of the conventional solution crystallization process, this heat cycle is somewhat different in that it has a twofold function—one to clean up the tailings and permit very high recovery, the other to act as a balance on thermal conditions in the plant. The heating of the brine pulp in grinding and agitating for flotation would cause potash to go into solution, only to be dropped out again in pipe lines and other places where there was likely to be any cooling. In the early stages of research it looked as if this thermal effect would be so troublesome as to necessitate water-jacketing of the flotation cells to maintain a uniform temperature condition. But by the practice outlined the expected difficulty has not only been avoided but a substantial contribution made to the process as a whole.

The high-grade concentrates, constituting the underflow of the middlings cells, go to the same cooling agitators as the warm brine, so that they are mixed with the crystallized potash, the coolers acting also to lower any temperature rises resulting from grinding and flotation agitation, thus maintaining control of thermal conditions in the plant. The cooled pulp overflowing from the cooling agitators is pumped to two sets of drag chain and Akins classifiers in series, which function to separate fine concentrates from coarse concentrates.

The pulp carrying the coarse material is conducted to two 48-in. continuous centrifugals, of the ter Meer design, built by Baker Perkins, Inc., of Saginaw, Mich., which reduce the moisture to about 4 percent. After centrifuging, the concentrate is conveyed to a plain gas-fired countercurrent drum dryer, whence it issues bone-dry. It is then handled on a water-jacketed drag conveyor to cool it sufficiently to permit carrying it by belt conveyor to the warehouses.

The pulp carrying the fine concentrate, plus the filtrate from the continuous centrifugals, runs to two Dorr thickeners. The thickened underflow is pumped to a salt-type filter, covered with monel-metal screen, which delivers a cake of about 9 percent moisture, the cake dropping on a flat belt conveyor, which carries it to two drum dryers exactly like the one used for coarse concentrates. Again the dried material is cooled on a water-jacketed drag conveyor, which deposits it in a small surge bin.

From the surge bin the fine, dry material is carried by drag chain conveyors to three briquet presses of the two-roll type, built by Komarek-Greaves & Co., of Chicago, each preceded by a conditioning mixer. A small amount of water is added in these mixers for a binding agent. The

presses make stick-like briquets of elliptical cross-section, about $\frac{1}{2}$x$\frac{3}{4}$-in. and 6 in. long, which are delivered by belt conveyors to a curing bin through which warm air is blown. After 24 hours in this warm atmosphere the briquets become hard. The water added before briquetting forms a brine which on evaporating leaves behind crystals to act as binders.

After "curing," or hardening, the briquets are crushed through two plain rolls, in closed circuit with a double-deck Hum-mer screen. From this screen is received a granular material approximately of manure-salt size, and a granular material of smaller size which is conveyed to a junction with the "Standard" or coarse concentrates. A third product is also obtained by means of a Western Precipitation Co.'s dust separator and "Multiclone" collector. The dust taken out of the crushed material by this means is returned to the briquet presses for repressing.

The "Granular" potash obtained by the means outlined in the foregoing has proved popular. Its large uniform size overcomes the tendency of the ordinary potash to cake and stick in grain drills, so that it is free-flowing and well adapted to "top dressing" of soils. It also stands storage without setting up for much longer periods than the smaller sizes.

The plant has three large warehouses for storage of its product, two for Standard Potash and one for Granular. The seasonal nature of the fertilizer-mixing business, which uses nearly all of the potash produced, makes necessary the provision of exceedingly large storage capacity. For potash the shipping season is largely concentrated in the fall and winter months.

The buildings themselves of the warehouses are interesting structures, built by Patterson Steel Co., of Tulsa, Okla. Exteriorly of an elongated turtle-back appearance, their cross-section is roughly half elliptic, with a lengthwise conveyor gallery on top. There are no interior supports, columns, trusses, or the like whatever, other than full span ribs carrying purlins, so that the concrete floor on which the potash is deposited is free of all obstruction. This is particularly advantageous for the system of reclamation used, comprising dragline scrapers to move the material to hoppers on the side in the floors. Beneath these hoppers are Jeffrey-Traylor magnetic feeders which feed the reclaimed potash to Jeffrey single-roll crushers, which break down any lumps occasioned by long storage. Conveyors of both the belt and Redler types are used to carry the broken-down material to screens which take out any small remaining lumps for reduction in Jeffrey hammer mills. The finished material, thus conditioned, is loaded into box cars by Manierre loaders. Two track scales are provided which permit the cars to be weighed both when empty and when loaded.

The mixing station for the production of potash of different contents of KCl is alongside the railroad. In it are two small cylindrical conical-bottom bins, beneath each of which is mounted a Jeffrey "Waytrol" constant-weight feeder. One bin is filled with low-grade potash of the grade usually mined; the other with high-grade concentrate. The Waytrol feeders are electrically controlled, so that they may be set to deliver the predetermined amounts required for any definite mixture or grade. Both deliver simultaneously on one conveyor belt, which discharges the combined materials continuously into a revolving drum mixer. The mixture or blend of the specified grade is then carried to the box-car loader, which distributes it in the box cars that are customarily used for shipments.

The final products as shipped are of a reddish-pink color, from which they have come to be known as "Red Muriate," an appellation sometimes startling to those accustomed to thinking of muriate of potash as a white salt. This color is due to the presence of a minute amount of iron. The finished product is a natural mineral, just as mined, except for the small amount recovered in the heat cycle. All that has been done to it, after mining, is to crush it down and float away the salt and clayey slime. In a certain sense it might be said to have been washed clean.

Patents Taken Out

A considerable number of patents have been granted the company covering the flotation of both potash and sodium chloride and details in connection therewith. Others are still pending.

The company produces a certain amount of the sulphate of potash salt by cooperation with the manufacturers of muriatic acid. In the ordinary process of making such acid common salt is treated with sulphuric acid and roasted in a Mannheim muffle furnace, the muriatic acid going off as a gas, there being left behind a residue of sodium sulphate, or salt cake, which is discharged as a byproduct. By the simple substitution of potassium chloride for sodium chloride it was found possible to obtain a high-grade potassium sulphate. Although muriate of potash, or potassium chloride, meets most fertilizer requirements, there are certain conditions for which the sulphate form is preferred. The company, therefore, is prepared to furnish various grades and sizes of muriate, and also sulphate in addition, so that it may take care of any requirements which may arise.

Research—From the very beginning the company has pursued a liberal policy with respect to research, the process used so successfully being the direct result of such research. The continuation of this policy has resulted in constant improvement of details of operation, in capacity of plant, and in character of product. The conditions of operation, involving the use of heavy saturated brines in which to treat ore of light specific gravity, were such as to render the ordinary rules of ore dressing, which became almost instinctive with operators of milling plants for metallic ores, quite inapplicable. It became necessary to learn an entirely new technique to meet the situation.

Employee Relations—The company, from its inception, has maintained a far-sighted policy in connection with employee-employer relations. Safety is stressed ahead of all other ends. Several safety trophies and Joseph A. Holmes Safety Association "Certificate of Honor" awards have been presented the employee group as a result of their united safety efforts.

A large majority of the employees reside in the city of Carlsbad, or its environs, but for a limited group of key men who are required by the nature of their jobs to live close to the plant, comfortable and attractive homes have been provided. A modern staff building to house unmarried staff members was constructed several years ago.

Employees' dwellings are modern in every respect. Natural gas is provided for heat and cooking; electricity is supplied for lighting and general household use. Modern plumbing is installed and connected to a distribution system supplied with soft water brought in by rail from the town of Carlsbad.

The company has endeavored to create working conditions which will be pleasant and safe and to further plans of employee security and welfare. Medical, hospitalization, and group insurance plans are examples of this. In connection with the group insurance, it was found, at the time these policies were written, that more than one-half of the employees had no life insurance. Today it is possible for the families of all employees to feel secure by knowing that in case of death there will be received a sum of insurance to help assist them in the trying period of readjustment. In addition, the weekly disability payments replace a good percentage of normal earnings of the employee in the event of illness or incapacitation from any cause.

A few years ago the practice of granting paid vacations to hourly wage employees was started. At that time this was a definite step in advance of national industrial procedure and even at the present time only a small percentage of industry grants this privilege.

The workings on Taluntunan orebody north of the Mogpog River, looking northwest along the strike. One wall appears at right

Iron Mine in the Philippines

The Gold Star, on Marinduque, is one of the Commonwealth's four producers

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THE GOLD STAR iron mine, one of the four principal iron ore producers of the Philippines, is in the northern part of the island of Marinduque, which lies between southern Luzon and Mindoro, about a day from Manila by boat. The property was acquired by the present owners in 1937. The presence of iron ore must have long been known, as huge boulders of magnetite are visible in the bed of the Mogpog river, where their weight, hardness, and strong magnetism serve to differentiate them easily from the usual débris.

No doubt the relative inaccessibility of the iron deposits caused them to be regarded as of doubtful economic value. The mine is about 21 km. from the coast. It was necessary to build 8 km. of private road for heavy trucking; as also several bridges and to strengthen those on the provincial road. A private pier had to be built at Port Balanacan, on the northwest coast, which fortunately has deep water. Ocean-going freighters can now stop there without difficulty.

Production began in August, 1938. Shipments were 16,939 metric tons in 1938; in 1939, 71,830 tons; in 1940, 116,627 tons, and for the first seven months of 1941, 81,880 tons. During August, 1941, operations were suspended on account of export-control measures in the Philippines, as well as inability to obtain shipping space. All Philippine iron ore has been necessarily shipped to Japan, which offers the only available market, and when this was closed, local iron mines had to suspend or curtail.

The deposits on Marinduque appear to be of the contact metamorphic type. The ore is principally magnetite with some hematite, and is of good grade, from 60 to 64 percent iron, with an average for the 287,227 tons shipped to date of 60.5 percent iron, with silica less than 5 percent, phosphorus about 0.02 percent, and sulphur about 0.1 percent.

The magnetite occurs at the contact of quartzites and quartz diorites. Apparently an intrusion of the latter in the overlying sediments resulted in metamorphosing the sandstones to quartzites. At a later period of the igneous activity magnetite concentrations occurred along the contact and partly replaced the quartzites. Still later considerable folding uplifted the deposits in some places to a steep angle. The upper part has been subjected to erosion, which has resulted in forming a placer of magnetite boulders in the river.

The principal orebody worked to date, known as Taluntunan, on the north side of the river, was originally well defined by the outcrop, which extended from the river bed northwesterly up the side of the ridge to a point 100 meters above the stream. Here the outcrop is buried beneath the surface, but reappears again about 600 meters northwest, where it is marked by massive iron boulders. Total length of outcrop from the river to a point near the top of the hill where stripping is in progress is about 250 meters. The orebody undoubtedly continues beneath the overburden until it reappears as noted. It has been mined for an average depth of about 5 meters and laterally about 40 meters. In the main the ore is clean. Whatever waste there may be is removed by sorting.

The east wall of the orebody as exposed by the benches is sharply defined. The magnetite bed appears to be overturned and has a crescent shape. Higher up the hill the bed flattens out and appears to be lenticular. There is little overburden on the 30-deg. slope. Near the top it is about 5 to 10 meters thick and is removed by a bulldozer.

Little development work or testing has been done on the orebody that is believed to lie below the overburden on the ridge. At the point where the magnetite boulders occur to the northwest a trench 4 ft. deep has been cut across the ore for 50 meters, and two pits, 4 and 10 meters deep, respectively, have been sunk in ore for their entire length. Both trench and pits show magnetite that assays 63 percent iron. This ore when mined can be transported at small cost by aërial tram to the bins 600 ft. below.

Assuming that the ore is continuous from the river to the outcrop on top of the hill, there is a length of upwards of 850 meters, with 650,000 tons of probable ore. It is recognized that orebodies of the contact metamorphic type are by no means regular and are subject to sudden changes that may make such estimates hazardous. In this instance, however, the orebody so far mined appears to be of uniform dimensions.

On the south side of the river, about 100 meters up, there is another massive outcrop of magnetite, 600 meters in length, that assays 50 to 60 percent iron. No development work has been done on it, but its potential tonnage appears large. There seems to be no connection between this deposit and the one described on the north side, although each has the same general strike.

Considerable development has been done and some ore shipped from the company's United claims, where the ore is of lower grade. The company also controls the Eureca group of claims, where a substantial tonnage of magnetite of good grade is indicated by an exposure of boulders and outcrops covering an area 400 by 30 meters. Interestingly, copper occurs with the iron, a sample across 13 ft. assaying 2.6 percent. Some specularite is associated with the magnetite.

The Taluntunan orebody is mined by open cut, using the conventional benches, spaced about 10 meters vertically. Both machine- and hand-drilling are used to break the ore. This is loaded into cars, trammed to the chutes, and sent down by gravity to the bins. The chutes slope about 30 deg. They are lined with old 20-lb. rails.

At this property the problems are mining the ore at minimum expense and transporting it to tidewater. Development cost thus far has been practically negligible, as the ore has occurred in plain sight on the surface, with little or no stripping. As work proceeds on top of the ridge, stripping cost will become an important item.

Philippine iron ore has been purchased by Japanese buyers for 8.50 pesos per metric ton c.i.f. Japanese ports, on the basis of 65 percent iron if the ore is magnetite, or 60 percent if hematite. A premium or penalty is demanded, as the case may be, for variations above or below these standards, with customary limits on silica, sulphur, and phosphorus. After paying 3.95 pesos freight to Japan, there remains 4.55 pesos per ton as the f.o.b. price in Marinduque for ore of standard grade. Evidently operating costs must be kept low if the mine is to make a profit on a relatively small output.

The wage scale for unskilled labor in Marinduque is low, and men are plentiful at 70 centavos per day. This contrasts with about 1.10 to 1.50 pesos per day for the gold districts of Baguio or Paracale. Mining costs at the Gold Star for an average month when 12,754 tons was mined and shipped are reported as follows:

	Pesos Per Ton
Labor, including mining and stripping	0.867
Explosives	0.220
Compressed air	0.093
Other mine supplies	0.116
Total mining cost	1.296

Transportation from mine to pier at Port Balanacan, 21 km. away, is effected by twelve 3½- to 4-ton trucks of standard manufacture. The road is fairly good, without heavy grades, and well surfaced. Both gasoline and diesel trucks are used, but the former are being replaced by diesels on account of the operating economy of the latter.

Each truck averages eight round trips per 24 hours from mine to pier, and consequently travels 336 km. daily. Drivers work 12-hour shifts, and are paid 7 centavos per ton of ore delivered to the pier, their wage averaging about 1.12 pesos per shift. Average cost per ton hauled before depreciation, but including tire cost, repairs, and maintenance, is reported to be 37 centavos per ton for the diesel trucks and 1.04 pesos for the gasoline trucks. It should be added that the gasoline trucks have seen two years' service, whereas the diesels are new. Average cost per ton hauled before depreciation during the seven months January-July, 1941, has been 91 centavos per ton, or 4.3 centavos per ton-kilometer. This is equivalent to 3.6c. per ton-mile.

Over-all operating costs before depreciation or depletion are reported as follows, under normal operating conditions when approximately 12,000 tons per month was mined and shipped.

	Pesos Per Ton
Mining cost	1.29
Transportation cost	0.91
Mine maintenance	0.08
Mine general expense	0.09
Ship loading	0.03
Total	2.40

These costs do not include the expenses of the head office, royalty, nor the production tax due the Commonwealth government on mine output.

An excellent pier for loading ore has been built at Port Balanacan. It can accommodate large ocean-going freighters. Trucks discharge into a 13,000 ton bin, with a slope of 33 deg. From the bin the ore passes through gates to a 250-ft., 24-in. conveyor belt, which delivers direct into the ship's hold. The loading capacity is 3,000 tons in 24 hours.

Placer Valuation in Alaska

II—Methods of Estimating the Gold Contents of a Block

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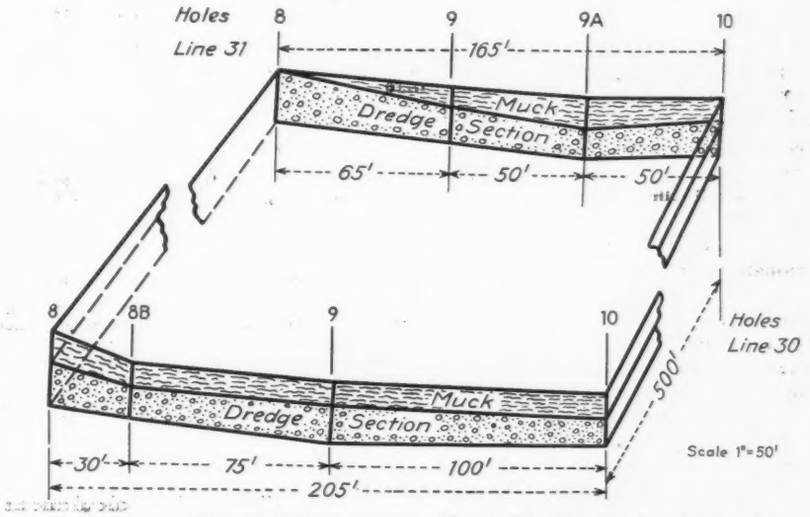

Fig. 1 . . . Diagram showing spacing of holes and the respective depths of muck and dredge-section in the block for which the value is calculated

A CONDENSED METHOD of estimating the yardage and gross production from the data secured in placer prospecting is described here. The accompanying diagram, Fig. 1, shows the spacing of the holes in the block taken as an example. The calculations are given in Table I. They use the double-end area method, which is an adaptation of the railroad and highway methods of estimating yardage.

In the diagram in Fig. 1 Line 30, Hole 8 is first. The spacing between 8 and 8B is 30 ft., so the depths of muck and dredge section are multiplied by the total distance between 8 and 8B. The value per cubic yard was taken to the base of the dredge section only, so it is multiplied by the factor of dredge section times spacing.

Next, Hole 8B is weighted by using the total spacing between Holes 8 and 9, or 105 ft. Hole 9 is then weighted for the distance between Holes 8B and 10, or 175 ft. Hole 10, similar to Hole 8, is an end hole, so the distance used here is only 100 ft. In this manner each spacing between holes has been weighted by two different depths and values; consequently the totals of the weighted factors are double.

The weighted average depth of muck is found by dividing the total of the muck factors by the total spacing, or 1,872 by 205, giving 9.1 ft. Similarly, the dredge-section depth is found by dividing 2,595 by 205, giving 12.6 ft. The average value per cubic yard is obtained by dividing 3,691 by 2,595 (dredge section times spacing times value per cubic yard divided by dredge section times spacing), giving $1.42.

Line 31 is weighted in the same manner as Line 30. The next step combines the line weights over the whole block between Lines 30 and 31.

The distance between the two drill lines is 500 ft., and the weighted averages for both lines have been

added. Therefore, to find the yardage and gross value, it will be necessary to divide by 54 instead of 27 as for a single-end area.

To obtain the muck yardage, the factors 1,285 and 1,872 are added, giving 3,157, which is multiplied by 500 and divided by 54, giving 29,200 cu.yd. The dredge-section yardage and the gross value are arrived at similarly.

Triangle Valuation

Block valuations are used principally for preliminary work and for annual production estimates. When the ground is mined, it is seldom that an entire block can be worked at one time. Very often reefs or spots of frost are encountered, so that portions of the block are never mined. Again the mining course might be such that parts of several blocks are worked in the same clean-up period. Often the time elapsed between the first recovery from a block and its complete mining is too long to wait for a check-up on the recovery.

By breaking the block into triangles, as is shown in Fig. 2, a closer control is possible for operating data. The two holes forming the *base* of the triangle have the largest influence on the factors per square foot for muck, dredge section, and value in any triangle. Yet the possibility of area adjacent to the two base holes is proportionately greater, and for the hole at the apex of the triangle the area is proportionately less.

Table II gives typical examples of the calculations for each triangle. It is seen that the average depths for muck and for dredge section are taken arithmetically. There are differences of opinion as to whether or not the arithmetical average is sufficiently accurate. In virgin placer ground it has consistently shown agreement with other weighted averages more involved. This method would not be accurate where there are deposits of drift tailings on the surface, muck partially stripped, or topographical irregularities. For these particular cases, contours and cross-sections with a classification of material would be used.

As a general rule, the material in a virgin placer deposit maintains a cross-sectional uniformity, but the values vary to any degree. In the work discussed in the foregoing the value per cubic yard is weighted against the depth of dredge section, as the value is taken to the base of the dredge section only.

Consider triangle 28 as an example. The total of the depths of muck and dredge section is divided by 3 to give 10.3 ft. and 11.0 ft. respectively. The average value is found by dividing the sum of the factors (value x depth dredge section), by the total sum of the dredge-section depths, or $\frac{40.41}{33} =$ $1.23.

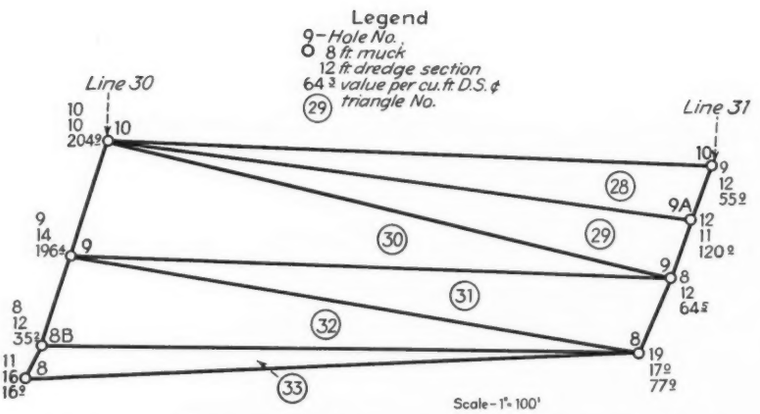

Fig. 2 . . . Diagram illustrating the manner of dividing up a block of ground into triangles for valuation purposes

Table I—Calculations for Block Valuation

Line	Hole	Spacing	Depth • Mk.	Depth • D.S.	Value Cu.Yd. D.S.	Mk. x Spacing	D.S. x Spacing	D.S. x Spacing x Value/Cu.Yd.	Block Spacing
31	8	65	0	19.0	77.9	...	1,235	961	
31	9	50	8	12.0	64.3	920	1,380	886	
31	9A	50	12	11	120.0	1,200	1,100	1,320	
31	10		9	12	55.9	450	600	335	
		165	7.8	13.1	81.2	2,570	4,315	3,502	
						1,285	2,157	1,751	C 500
30	8	30	11.0	16.0	16.9	330	480	81	
30	8B	75	8	12	35.2	840	1,260	443	
30	9	100	9	14	196.4	1,575	2,450	4,810	
30	10		10	10	204.8	1,000	1,000	2,048	
		205	9.1	12.6	142.0	3,745	5,190	7,382	
						1,872	2,595	3,691	

• The abbreviations "Mk" and "D.S." are for "Muck" and "Dredge Section"

Calculations

Muck	Cu.Yd.	Dredge Section	Cu.Yd.	Gross Value	$
1,285		2,157		1,751	
1,872		2,595		3,691	
$\frac{3,157 \times 500}{54}$	= 29,200	$\frac{4,752 \times 500}{54}$	= 44,000	$\frac{5,442 \times 500}{54}$	= $50,400

Table II—Calculations for Triangle Valuation

Tri.	Line	Hole	Depth Mk.	Depth D.S.	Value Cu.Yd. D.S. $	Value x Depth D.S.	Av. Depth Mk.	Av. Depth D.S.	Value Cu.Yd. D.S. $	Factors/Sq.Ft. Cu.Yd. Mk.	Factors/Sq.Ft. Cu.Yd. D.S.	Factors/Sq.Ft. Value $
28	31	10	9	12	0.559	6.72						
	31	9A	12	11	1.200	13.20						
	30	10	10	10	2.049	20.49	10.3	11.0	1.23	0.382	0.407	0.502
			31	33		40.41						
		9A	12	11	1.20	13.20						
29	31	9	8	12	0.643	7.70						
	31	10	10	10	2.049	20.49	10.0	11.0	1.25	0.370	0.407	0.510
	30		30	33		41.39						

The ultimate use of this valuation is based on the unit square foot. After a clean-up period, the parts of each triangle are measured by planimeter to get the total square feet in each triangle mined. The sum of all the triangle areas is checked back to the total area in the clean-up for a closure.

The average depths of material in a triangle are converted into factors per square foot by dividing the depths by 27. The result is 0.382 and 0.407 cu.yd. of muck and dredge section, respectively. The average value per cubic yard of dredge section was $1.23; the average cubic yard of dredge section in the triangle was 0.407 per square foot. Therefore $1.23 \times 0.407 =$ 50.2¢ per square-foot average value.

During the mining operation depths are recorded regularly and averaged for the clean-up period. The total yardage (recovered) is calculated on this basis.

The area of each triangle mined is then multiplied by each of the three factors, and the total of each completes the estimate. A comparison of these results with the actual recovery is then made.

The Evasee on a Centrifugal Exhaust Fan

A study in ventilation, to determine its effect

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WHEN a centrifugal exhaust fan is operating without an evasee[1] on its discharge, the air flows to atmosphere at high velocity and its kinetic energy is wasted. If one is placed on the discharge, part of the velocity pressure may be converted into static pressure, helping to overcome the resistance of the duct leading to the fan.

Specific problems are to be discussed here, as follows:

Given a fan, the static and total-pressure - volume characteristics of which, when tested as a blower at a given density and speed, are known. The power and efficiency curves are also given. The fan is operating as an exhauster, and the rate of flow is known.

(a) What will be the rate of flow if an evasee is placed on the fan, and what will be the efficiency and power consumption?

(b) What conditions warrant the installation of the evasee?

Terms—The terms, "total pressure of air," "fan total," and "duct total" are explained in the following paragraphs, preliminary to the discussion:

The "total pressure" of air at a point is the static pressure plus the velocity pressure at the point: velocity pressure expressed in inches of water is calculated by the formula:

$$V.P. = \frac{X}{0.075}\left(\frac{V}{4{,}000}\right)^2$$

$V.P.$ = Velocity pressure in inches of water.
X = Density of air (lb. per cu.ft.)
V = Mean velocity in feet per minute.
Velocity pressure is always positive.

Example: All pressures will be expressed in inches of water, and static pressures will be gage pressures. Fan is exhausting from one duct and blowing into another. Manometer on intake reads -3 in., and $V.P.$ at this point is 1 in. Total pressure at this point is then $-3 + 1 = -2$ in. Manometer on discharge side reads $+4$ in., and $V.P.$ at this point is $+2$ in. Total pressure is then $+4 + 2 = 6$ in.

[1] Évasée is a French participle meaning "flaring outward," but in the English nomenclature it is used as a noun meaning "expanding chimney." The accents are omitted in the article.

The "total pressure" of a fan for a given quantity or, better, the "fan total" to distinguish it from "total pressure" of air at a point, is the increase in total pressure of the air caused by the fan. In the example given, the total pressure of the air in passing through the fan is raised from -2 to $+6$, or a total of 8 in. This is the fan total for the quantity circulating.

An easy rule to remember is: the fan total is equal to the rise in static plus the velocity pressure at discharge minus the velocity pressure at inlet. In the example, the static pressure rose from -3 to $+4$, or 7 in. Adding 2 and subtracting 1, the fan total is 8 in. For a given quantity and speed and air density the fan total is the same whether the fan is operating as a pressure fan or an exhauster.

Test Curves—Fig. I shows the curves of the fan that is to be discussed. The test curves are A, B, C, and D. As stated at the outset, the fan has been tested as a blower at constant speed, and the curves have been plotted for a standard density of 0.075 lb. per cu.ft. The fan has been operated with different gate openings on the duct, and at each opening the following measurements were taken: static pressure at discharge, mean velocity at fan discharge in feet per minute, horsepower delivered to fan shaft, and density of the air. The area of the fan discharge in square feet times the mean velocity is the quantity per minute designated in following formula as Q. The velocity pressure at fan discharge is calculated and added to fan static to give fan total.

The efficiency is then calculated by the formula

$$\text{Efficiency} = \frac{\text{Fan total in inches} \times 5.2 \times Q}{33{,}000 \times \text{Input horsepower}}$$

The fan static, fan total, and horsepower curves are changed to what they would be if the density during test had been 0.075. This is done by multiplying test values for each quantity by $\frac{0.075}{X}$ where X is the actual density during test. Efficiency and quantity are not affected by variation of density.

When a fan is placed on a duct system, the rate of flow is determined by the intersection of the fan-total characteristic and the duct-total characteristic. "Duct-total pressure" for a given quantity Q is equal to the sum of the friction and shock losses through any path plus the velocity pressure in the air that is thrown to atmosphere. This is true whether the air leaves the shaft to atmosphere, as would be the case with a blowing fan, or leaves the fan discharge to atmosphere, as would be the case with an exhaust fan.

Exhaust Fan Operating Without Evasee—Let it now be assumed that the fan, having the curves shown in Fig. 1, is operating on a mine as an exhauster and 28,000 cu.ft. per minute is circulating. Let the density of the air be 0.075 lb. per cu.ft. Let it be further assumed that no natural ventilation pressure is present. For this quantity it is seen that the fan total is 3.25 in., the efficiency is 79 percent and the horsepower required is 18.1.

As the flow is determined by the crossing of the fan and duct total curves, the duct total pressure for the quantity must also be 3.25 in. The entire duct-total curve may now be calculated, assuming that the friction factor is constant, by using the rule that the pressure varies as the ratio of the squares of the quantities. For example, the duct total for 20,000 is $\left(\frac{20{,}000}{28{,}000}\right)^2 \times 3.25 = 1.65$ in. The duct total is shown as Curve E in Fig. 1.

Operating With an Evasee—Consider a fan as in Fig. 2 without an evasee exhausting from a duct. The duct total is the pressure necessary to balance the friction and shock losses plus the velocity pressure in the air as it leaves the fan.

Example: If the friction and shock losses add up to 3 in. and the air leaves the fan with a velocity pressure of 1 in., the duct total is 4 in.

Now if an evasee is placed on the fan as in Fig. 3, it should be considered as part of the duct. The duct-total with the evasee in place will, for any given quantity, lie below the duct-

total curve without evasee because the final velocities are less. This new duct-total curve will intersect the fan-total curve to the right of the original curve, and the crossing indicates that the evasee has increased the rate of flow. Since the duct-total curve without evasee is already plotted, it would be advantageous merely to apply to this curve a correction to obtain the curve with evasee. We proceed about this as follows:

Considering Fig. 3, the velocity leaving the fan is v_1 ft. per second, and the velocity at the top of the evasee is v_2 ft. per second. For the quantity involved the duct-total is reduced, if the conversion is perfect, by

$$\frac{w}{5.2}\left(\frac{v_1^2 - v_2^2}{2g}\right) \text{ inches of water}$$

w = Density in lb. per cu.ft.
v_1 = Mean velocity at fan discharge in ft. per second.
v_2 = Mean velocity at evasee outlet in ft. per second.
g = Acceleration due to gravity.

Velocity pressure has been converted into static pressure. Some shock loss always occurs in the evasee, so the conversion is never perfect. If the fraction of the available difference in velocity pressures that is recovered is called K, the recovery is

$$\frac{Kw}{5.2}\left(\frac{v_1^2 - v_2^2}{2g}\right) \text{ and the shock loss is}$$

$$\frac{(1-K)}{5.2}\,w\left(\frac{v_1^2 - v_2^2}{2g}\right)$$

If F is the friction loss and S is the shock loss in the duct in inches of water, the duct total without evasee is

$$F + S + \frac{w\,v_1^2}{2g \times 5.2} \qquad (1)$$

With evasee, for the same flow the shock loss is increased and terminal velocity decreased and the duct total is

$$F + S + \frac{(1-K)}{5.2}\,w\left(\frac{v_1^2 - v_2^2}{2g}\right) + \frac{w\,v_2^2}{2g \times 5.2} \qquad (2)$$

If 2 is subtracted from 1, it is seen that they differ by $\frac{K}{5.2}\,w\left(\frac{v_1^2 - v_2^2}{2g}\right)$, which is the velocity pressure converted into static pressure in the evasee. So to convert duct-total without evasee into duct-total with evasee, assume any quantity and calculate the pressure recovered in the evasee. Subtract this from duct-total without evasee, and the result is the duct-total with evasee for the quantity. The correction for one quantity may be calculated and the rest computed by the law that the recovery varies as the square of the quantity. Incidentally, the static pressure at the throat will be below the atmospheric pressure by the amount of the conversion.

A good evasee will convert about 80 percent of the difference of the velocity pressures. A rough rule for the outlet area of the evasee is to make it four times the area of the fan outlet. With such an evasee the final velocity at top of evasee would be one-fourth of the velocity at fan discharge, and the velocity pressure lost would be only one-sixteenth of the velocity pressure at discharge of fan. With $K = 0.8$ the recovery would be $0.8 \times \frac{15}{16} = 0.75$; that, is 75 percent of the velocity pressure leaving the fan discharge would be converted into static pressure.

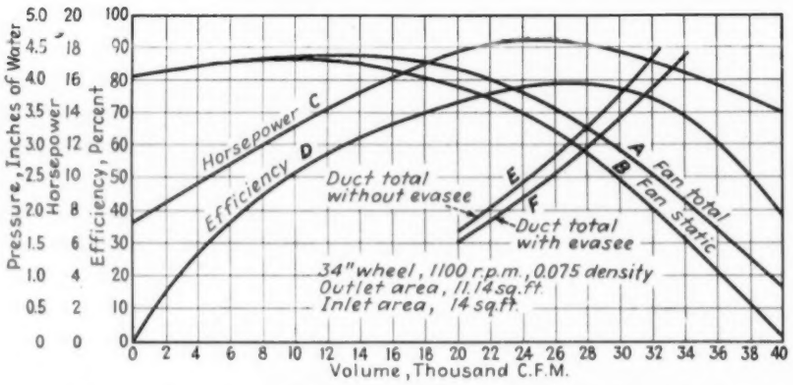

Fig. 1 . . . Fan and duct performance curves, using backward-turned blades

Example: Assume any quanity, say 20,000 cu.ft. per minute.

Velocity at outlet $= \frac{20,000}{11.14} =$ 1,795 ft. per minute.

Velocity pressure $= \left(\frac{1,795}{4,000}\right)^2 =$ 0.20 in.

0.75 x 0.20 = 0.15 in., the recovery.

Recovery varies as the square of the quantity; so for 10,000 cu.ft. recovery is

$$\left(\frac{10,000}{20,000}\right)^2 \times 0.15 = 0.075 \text{ in.}$$

The duct-total with evasee may now be calculated from the duct-total without evasee for each Q by subtracting the recovery from the duct-total without evasee. Curve F, Fig. 1, is the curve with evasee.

Noting the crossing of this new curve with the fan-total characteristic, one sees that the effect of the evasee is to increase the flow of air 800 cu.ft. per minute, decrease the horsepower about 0.1 hp., and decrease the efficiency slightly. In this particular case 800 cu.ft. more air per minute is obtained with a slight decrease in horsepower. If this is worth the capital charge on the evasee, one should be installed. One way of converting the saving into dollars and cents is to compare the horsepower required with the evasee with the horsepower that would be required to obtain the same quantity by increasing the speed without evasee.

Example: The horsepower for 28,000 without evasee is 18.1. Quantity varies directly as the speed and horsepower varies as the cube of the speed and so as the cube of the quantity. To obtain 28,800 the horsepower required would be

$$\left(\frac{28,800}{28,000}\right)^3 \times 18.1 = 19.7 \text{ hp.}$$

If the extra air is desired, it may be obtained with the evasee at a saving of 1.7 hp., compared with obtaining it by increasing fan speed. If the saving in power is greater than the capital charge on the evasee, then the evasee is warranted.

Now let it be assumed that no more air is desired and that the fan speed can be decreased. With the evasee in place what must be the fan speed to give the original quantity, and what saving is effected by the evasee? With the original fan speed, 28,800 cu.ft. per minute are circulating and the horsepower is 18.0. To give the original quantity the speed must be reduced in the ratio of the quantities.

Speed to give

$$28,000 = \frac{28,000}{28,800} \times 1,100 = 1,070$$

Power changes as the cube of the speed or quantity.

$$\text{Hp.} = \left(\frac{1,070}{1,100}\right)^3 \times 18.0 = 16.6 \text{ hp.}$$

With the evasee in place and the original quantity it effects a saving at reduced speed of 1.5 hp. This saving should be compared again with the capital charge on the evasee to determine its desirability.

The fan under discussion has backward-turned blades and so has a non-overloading power curve. If it had been a fan with forward blades, the power curve would have risen throughout the range of quantity and the addition of an evasee would always increase the amount of power that is consumed.

To simplify the exposition, the density of air at the mine has been assumed as 0.075, the density at which the curves of the fan are plotted. If the density at the mine has another

value, x, the static and total pressure and the horsepower for each quantity should be multiplied by $\frac{x}{0.075}$ and new curves plotted. Quantity and efficiency are not affected by change of air density.

Problem With Natural Ventilation—Assume as before that 28,000 cu.ft. per minute is circulating without evasee, and assume also that a 1-in. natural ventilation pressure (N.V.P.) is against the fan. The fan total will appear on the diagram as before (Fig. 4). Draw N.V.P. as a straight horizontal line. With 28,000 cu.ft. in circulation, the fan total must always be 3.25 in. As 1 in. is consumed by N.V.P., the duct total for this quantity must be 2.25 in. for 28,000. Using this as a start, the rest of the duct-total is computed by the square law. The effect of the evasee is determined as before by subtracting recovery from duct-total without evasee.

If speed of fan is changed, the fan laws no longer apply. They apply only when total resistance varies as the square of the quantity circulating. To determine what happens when speed is changed, new fan curves for new speed must be plotted. Methods for doing may be found in texts.[2]

If N.V.P. is with the fan, consider it as a pressure source in series with the fan (Fig. 5). With 28,000 cu.ft. per minute circulating, the fan total is 3.25 in. The pressure that causes the flow is, however, 4.25 in. With this pressure and 28,000 as the base the duct-total is computed. Duct-total with evasee is derived as before. New fan curves must be plotted for different speeds.

A study of the construction of the evasee was made by Briggs and Williamson[3] with the following conclusions:

1. An evasee expanding equally in both directions (i.e., back-to-front and side-to-side) is most efficient when the angle between opposite walls is 7 deg.

2. An evasee expanding equally is, at its best, more efficient than one expanding in one direction only.

The usual method of calculating the power saved by the evasee is to consider only what happens in the chimney. It is now evident that this is not the whole story, because an evasee always increases the flow, and depending on the fan curves and the mine characteristic the power used may be increased or decreased by the construction of an evasee on the fan. If the evasee is to be placed on a fan not yet installed, the duct-total curves and flow must of course be determined entirely by calculation.

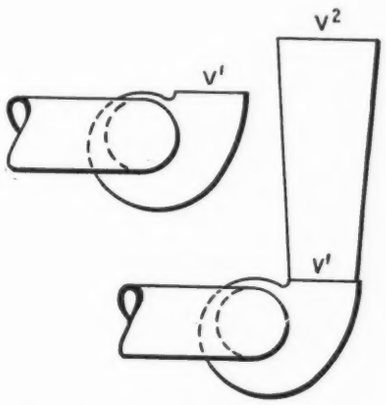

Fig. 2 (upper right) and Fig. 3 . . . Fan without evasee and with evasee respectively

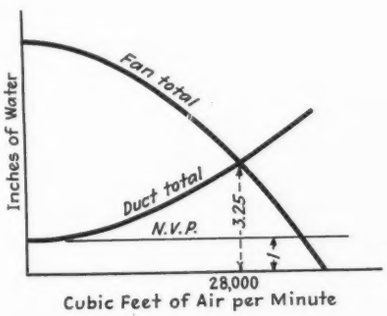

Fig. 4 . . . Illustrating the effect of a 1-in. natural ventilation pressure (N.V.P.) against the fan

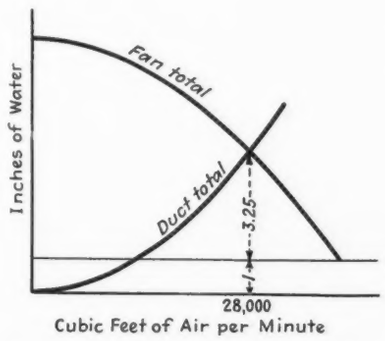

Fig. 5 . . . The curves when the 1-in. natural ventilation pressure is with the fan

[2] Weeks, W. S.: "Ventilation of Mines." McGraw-Hill Book Co., Inc. 1926, page 102.

[3] Briggs, Henry: "The Ventilation of Mines; Generation of the Air Current." Methuen & Co., Ltd., 36 Essex St. W. C., London, 1929.

Fluorspar Producer in Illinois Tries Quebracho Extract in Flotation

Raises grade of lead concentrate but not recovery

IN U. S. PATENT 2,168,762 (Method of Concentrating Fluorspar Ores Through Use of Quebracho Extract) is the statement:

"Our method is also effective for recovering acid-grade fluorspar directly from ore pulp before removal of the metallic sulphides and containing considerably greater quantities of the latter than the said [sulphide] tailings. Thus an ore containing 1.75 percent Zn, 0.81 Pb, 84.0 CaF_2 and 5.0 $CaCO_3$, after being ground to —100 mesh, was pulped, treated with 1.0 lb. oleic acid and 0.25 lb. quebracho extract per ton of dry feed, and agitated to produce a froth. The flotation concentrate obtained therefrom assayed 99 percent CaF_2, 0.03 Pb and 0.05 Zn, and the tailings contained 3.6 percent Pb and 5.98 Zn; that is, 96.8 percent of the lead and 97.9 percent of the zinc present in the original ore were excluded from the fluorspar concentrate recovered."

The Mahoning Mining Co. at its Rosiclare, Ill., plant, where it is treating complex galena-sphalerite-fluorspar ores to produce marketable concentrates, has been studying the effect of quebracho extract in the galena circuit in depressing sphalerite and other constituents and in improving the grade of the lead concentrate. Because of the presence of carbonaceous or bitumen-like material in these ores, production of a very high-grade lead concentrate has not been possible. This organic material tends to promote the flotation of the sphalerite and of other impurities in the circuit. It has been found, however, that very small amounts of quebracho extract, such as 0.01 to 0.03 lb. per ton of feed (much less than the 0.25 lb. mentioned in the foregoing patent) have a beneficial effect in depressing the sphalerite and other impurities in the galena circuit and still do not decrease the percentage recovery of the galena. For example, for a month, July 8 to Aug. 7, 1940, when quebracho extract was not used, the lead concentrate averaged 58.27 percent Pb and 13.0 Zn. For the month Aug. 7 to Sept. 7, 1940, with 0.01 to 0.03 lb. quebracho extract in the galena circuit, the lead concentrate averaged 66.27 percent Pb and 9.31 Zn. The extractions for the two months were the same—slightly more than 91 percent.

Results from test work on ores from the Tri-State district, the Wisconsin zinc district, and the Southeast Missouri lead district indicate a comparable behavior in the use of limited amounts of quebracho extract.

A 1¾-cu.yd. Northwest shovel loading placer gravel in Koehring dump truck and Ford truck. Jack Richards' operations on Alma placer, Alma, Colo.

Some Unique Dump-Truck Placers in Colorado

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NOT SO LONG AGO the placer miner set up his wash box, shoveled gravel into it by hand, forked out the coarse material with a rock fork, and washed the fines through a short sluice box, from which he recovered his gold dust and nuggets. In fact, such operations are still going on and can be seen in Colorado alongside of refinements of such methods which have reached the point where one operation handles 3,000 cu.yd. per day at an over-all cost of 8¢ per cubic yard mined and washed.

At several points along the modern highway between Alma and Fairplay, Park County, Colo., traveling is slowed down where gravel-laden dump trucks cross in order to reach washing plants situated on the slopes between the highway and the South Platte River. The gravel is dug on the west flank of the large Snowstorm placer, a ridge of glacial detritus extending southward from Alma to Fairplay, some 6 miles. Desultory placer operations had been going on here for some time, but the introduction of a little system and the digging of a ditch from Alma along the west side of the placer, so that plenty of water is available, have made this region the haven of five small-scale operators. They started on a shoestring, but have developed the old wash box to the point where it means employment to many and profit in their pockets.

The most primitive operation consists of a ¾-cu.yd. shovel, which digs gravel in an open pit and transports it to a wash box under the ditch half a mile away, where the coarse is still forked out and the fines pass through a 20-ft. sluice box about 18 in. wide. This is a two-men operation. The men dig the gravel, transport and wash it, and repeat this cycle as many times during the day as they can.

Not far away is the washing plant of A. Palmos, locally known as "The Greek," or "Tom." His operations are on a little larger scale and he employes five men per shift and runs about 300 cu.yd. of high-grade gravel per day. At his plant a 12x12-in. launder supplies a constant stream of water to a steel hopper, into which the gravel is dumped and washed. At the lower end of the inclined hopper, or wash box, about 10 ft. wide at the upper end and narrowing down to 3 ft. at the lower discharge end, there is a grizzly gate operated through a lever attached to a cable and windlass by one man, who opens the gate when the coarse rocks have been sufficiently washed. The material is discharged through this gate over an inclined, reinforced wire screen with 2-in. openings, the fines and water dropping through into a sheet-iron launder. From this they pass into a riffled sluice about 50 ft. long and 2½ ft. wide. No attempts are made to save fine gold. After passing the screen, the coarse rocks drop into a small receiving hopper, from which they are removed by dump truck to the coarse tailings dump, arranged in a circle.

On their way across the screen and into the waste hopper, the rocks—and some are large ones—are retarded by two baffles. One of these is made of heavy rails, set about 3 in. apart; the lower one consists of six old automobile tire casings suspended from a 1½-in. iron bar. Though primitive, they seem to work admirably and serve the purpose for which they are intended.

A ¾-cu.yd. shovel digs the gravel, which is then hauled to the plant about half a mile by two Ford dump trucks of 2-cu.yd. capacity each. One man operates while another drives the truck on the tailings dump. Except for operating the shovel and trucks, no power is required.

A short distance away a similar plant is in operation, which, however, has taken another step. Instead of using an inclined, stationary screen, it has a trommel screen 25 ft. long and 4 ft. in diameter. Gold-saving tables are arranged under the screen, fol-

lowed up by a riffled sluice discharge box. Five such operations are under way on the Snowstorm placer. Four of them dig with 1¼-cu.yd. shovels and one uses a ¾-cu.yd. shovel. There is considerable coarse gold, and nuggets are not uncommon. Screen perforations on these outfits are usually 1 in. in diameter.

The ground is leased to the operators by the Timberline Dredging Co. on a 20 percent royalty basis. This seems a high royalty, but the leasers have one advantage. The ground was carefully sampled during 1934, so that the operators have some idea of the value of the gravel being dug. A similar plant, using a trommel screen, is now being assembled by Earl Coryell on the Beaver Creek side of the Snowstorm placer. The Detweiler brothers, placer drillers of Breckenridge, Colo., own the ground which is to be worked by Coryell.

The most advanced stage of dump truck placer mining in the district is carried on by Jack Richards, at Alma, on the Alma placer, which is a northward continuation of the Snowstorm placer.

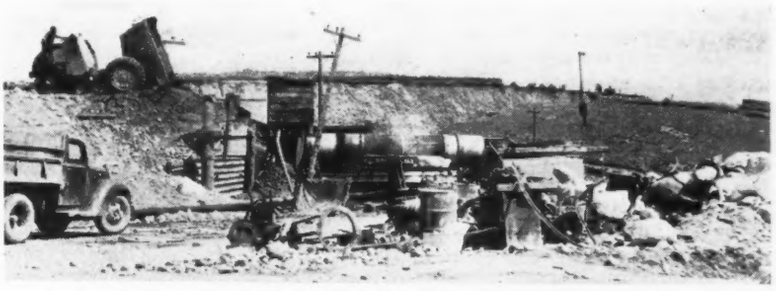
The arrangement of hoppers, electrically driven trommels, screens, gold-saving tables, and sluices is similar to those already described, but as the gravel here does not contain many large rocks, there is no gate in the feeding hopper. Instead, an improvised giant made of 2½-in. pipe and two elbows and operated by one man plays water onto the material as it is dumped into the hopper and regulates the flow of gravel into the screen, which is provided with inside and outside spray pipes. Screen perforations are 1 in. in diameter. Two plants, about 100 ft. apart, are operated by Mr. Richards.

The gravel is mined down to bedrock in an open cut 150 ft. wide with vertical banks 50 to 60 ft. high. Undercutting is done with the shovel, and the banks are allowed to cave. A diesel-powered Northwest shovel using a 1¾-cu.yd. Amsco bucket digs the gravel and loads it into two Ford dump trucks each hauling about 3 cu.yd. per trip and two diesel-operated 5-cu.yd. Koehring dump trucks. The length of the haul made with this equipment is about 1,000 ft.

Water is furnished from a ditch about 75 ft. above the plants, through two 12-in. penstocks about 400 ft. long, so that the giants in the hoppers and the screen spray pipes operate under a head that assures considerable pressure.

The placer ground lies at an elevation of 10,400 ft. The crew per shift consists of one shovel operator, six truck drivers, two feeders, and two roustabouts. Three shifts are worked. The operation handles up to 3,000 cu.yd. per day at the surprisingly low over-all cost of 8¢ per cubic yard. The placer ground is owned by Carey W. Rhodes, who receives a 20 percent royalty from the operators of the property.

These dump-truck placer operations in Park County, lying at elevations ranging from 10,000 to 10,500 ft., are carried on from April or May into October. They add considerably to Colorado's placer gold output, and the simple yet efficient methods employed may find use in other parts of the State.



One of Jack Richards' washing plants on Alma placer. A truck is dumping into the feed hopper. The operator of the giant sits in the small shack above the trommel. Note the outside sprays on the screen

Placer gravel washing plant of A. Palmos between Alma and Fairplay, Colo. Water launder to left, sluice box under shed to right. Auto tire casings baffle gate in discharge chute below level of oversize discharge gate

Dump-truck placer washing plant of Earl Coryell being assembled on Beaver Creek, near Fairplay, Colo.

An old-timer. Most of the drill testing on the Snowstorm placer has been done by Detweiler Brothers, of Breckenridge, Colo., with this old, steam-powered No. 3 Keystone drill, which is still in operation

Reclaiming Metals and Alloys From Industrial Wastes

Mineral-dressing processes can be applied to this end

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F. A. Paciotti — *Research Engineer*
Michigan College of Mining and Technology
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GREATLY increased consumption of metals, and the resultant scarcity, have intensified interest in secondary metals. Hand picking and magnetic separation have long been used in reclaiming the latter, but other methods of mineral dressing have received relatively little consideration. Here we wish to call attention to the possibility of applying mineral dressing processes to reclamation of metals and alloys from industrial wastes, by citing research done in the laboratory of the Michigan College of Mining and Technology on drosses, dusts, and sludges and in investigating subsequent commercial operation of such processes on a grinding sludge.

Drosses consisting of metallic copper, metallic tin, their oxides, and alloys of copper and tin are being studied. Laboratory experimentation with differential grinding, screening, tabling, and leaching has given promising results.

A sludge from grinding high-speed tool-steel pieces was beneficiated by flotation and tabling. In flotation, the finer part of the tool steel was collected in a satisfactory concentrate. The tailing containing the rest of the tool steel and grinding-wheel abrasive and bond was tabled, separating the abrasive and bonding materials from the coarser part of the tool steel. This problem has been thoroughly studied, and commercial plant tests will be undertaken soon.

Other grinding dusts and sludges have responded to flotation and tabling. One sample contained only high-speed tool steel as the valuable material; another contained high-speed tool steel and an alloy of cobalt, chromium, and tungsten, and a third contained high-speed tool steel and an alloy of cobalt, chromium and tungsten and tungsten carbide. With these samples, separation of the valuable alloys from bonds and abrasives and common steel was required as well as separation of the desired alloys into individual products. Some of these separations have been made with flotation, and further research will make it possible to produce commercially, from the third sample, a high-speed tool steel and an alloy (of cobalt, chromium, and tungsten), and a tungsten carbide product.

Finally, a study of a grinding sludge composed of "Crobalt,"[1] common steel (from alloy bit holders) and grinding-wheel bond and abrasive was made and carried through to satisfactory commercial operation.

Steps in the process as finally applied were: feeding, screening to remove large foreign objects, disintegration, aeration, tabling, and flotation of the table tailing. A large part of the alloy was recovered on a Wilfley table in a high-grade concentrate, taken from the table where slimes are usually overflowed. The presence of the alloy on this part of the table was due not only to its fine size and shape (thin cuttings) but also to its non-wettability. This condition of non-wettability in turn was brought about by the alloy's chemical nature (metal carbides) and possibly by adsorption of excess lubricant from the grinder lubrication. Thus the alloy, although of much higher specific gravity than the binder or abrasive, concentrated on the part usually occupied by fine particles of lowest specific gravity. This concentration, however, was not due to agglomeration; instead, the particles were concentrated as individual particles—some were washed over the riffles as in usual tabling; others were carried over the riffles by film flotation. Only pure water, and no emulsifying oil or similar material, was used as the cooling medium in the grinding that produced the sludge, whereas some sludges previously discussed here had been made in the presence of emulsifying oils, thus requiring special treatment with wetting agents before floating and tabling.

In addition, there were streaks of binder, abrasive, and coarse alloy, these being named in order of position on the table when passing from the slime to the concentrate portion. Also, various-sized alloy and common-steel particles were intermixed with binder and abrasive, the table tailing. This fact made desirable the application of some method of minerals separation other than gravity concentration to the table tailing, as further separation on this principle could not be hoped for when the size and other properties of the alloy were such that it appeared at both the slime and concentrate ends of the table. As the tailing was relatively fine, flotation seemed a likely method of recovering the alloy from it. Separation of the alloy from the binder and abrasive was made either by floating the binder and abrasive and depressing the alloy and common steel with Reagent 1248,[2] sulphuric acid, and pine oil or by floating the alloy and depressing the binder, abrasive, and common steel with Reagent 1248, sodium cyanide, and pine oil. As the latter procedure also separated the alloy from common steel, it was applied; it functioned satisfactorily in the commercial operation. The process was easily applied and produced a good recovery of the alloy in a concentrate of satisfactory grade that has filled all requirements.

Thus it has been shown that considerable recovery of metals from industrial wastes has been made by simple tabling and that almost unlimited applications of flotation to these problems are possible by varying the reagent combinations. To date various combinations of pine oil, fuel oil, sulphuric acid, sodium hydroxide, Reagent 1248 and similar reagents, the xanthates, sodium cyanide, heavy metal salts, fatty acids, and cationic reagents have floated or depressed the various components of the grinding sludges and produced satisfactory concentrates of individual metals and alloys. Thus mineral dressing has proved of definite worth — especially at this time — in salvaging highly strategic materials from wastes. In addition, the economic significance of such application can be realized when the prices of such metals as cobalt, tungsten, and chromium are considered along with the fact that many of these sludges formerly thrown away contain as much as 60 percent of these metals.

We gratefully acknowledge the aid received from G. C. Dillman, president of the Michigan College of Mining and Technology,[3] and N. H. Manderfield, professor of mineral dressing. We are especially indebted to Charles Baird, president, Ann Arbor Grinding Co., 1354 North Main St., Ann Arbor, Mich., who brought to the attention of the College the problem last discussed and the possibility of beneficiating grinding dust and sludges as a whole, furnished samples, and cooperated in the plant tests that led to commercial operation—these tests having been made in the above company's plant.

[1] A cast chromium, cobalt and tungsten cutting alloy.

[2] Thus designated for want of a better knowledge of its chemical nature.

[3] Patents on reagents and processes described have been applied for, and all rights are reserved, by W. E. Keck, assignor to Michigan College of Mining and Technology.

Mining on the Menominee

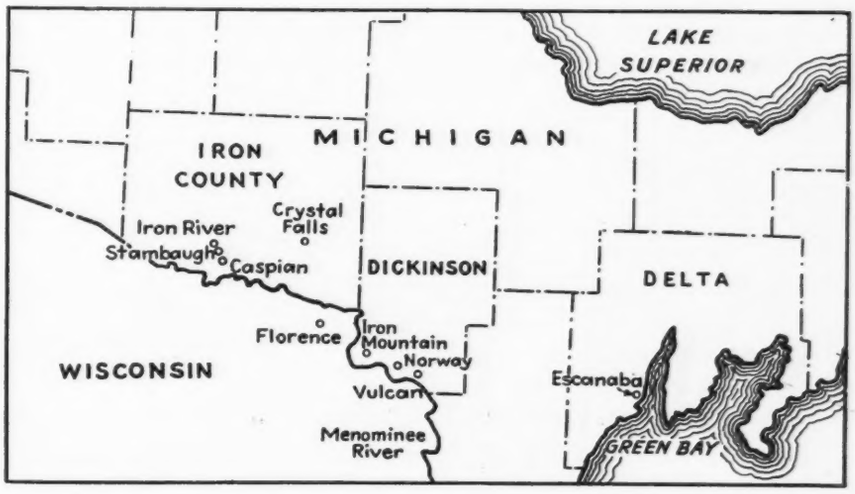
A picture of current operations in facts and photographs

A. H. Hubbell
Associate Editor

SHIPMENTS OF IRON ORE from the Menominee Range began in 1877, just 65 years ago. Since then up to the end of the 1940 season, approximately 189,000,000 tons of ore has gone from its mines to Escanaba, on Lake Michigan, and from there by boat down to the Lower Lake ports. To this total the shipping season that ended a month ago added approximately 4,167,500 tons. Indications of iron on the Range were first reported between 1846 and 1849[1], exploration started in 1866, and sinking of the first shaft began in 1872. Annual shipments first reached 1,000,000 tons in 1882, exceeded the 6,000,000 ton mark in each of the years 1916 to 1918 inclusive, and almost touched that figure again in 1929.

The Menominee is one of the three Lake Superior iron ranges that are situated in northern Michigan, and gets its name from the Menominee River, which traverses it, at the same time forming the boundary between the Upper Peninsula and Wisconsin. The huge tonnage of ore shipped in six and a half decades has come from 129 mines, of which only 24 were listed as shippers in 1937. Today the number of active mines is under 20. A reason for the decline, which is now for the time at least reversing itself, is to be found in the gradual exhaustion of reserves of the high-grade ores coupled with the fact that much of the remaining ore is relatively high in phosphorus, silica, and sulphur, for which the outlet is narrower. Crystal Falls, Iron River, Iron Mountain, and the Norway-Vulcan area, in Michigan, and Florence, Wis., just across the State line, have been the chief centers of mining.

[1] Carl Zapffe, in a chapter entitled "Discovery and Early Development of the Iron Ranges," in the handbook on "Lake Superior Iron Ores," published in 1938 by the Lake Supereior Iron Ore Association. To the latter association we are also indebted for the shipment figures cited.



Today the producing properties comprise 13 mines in the Iron River district, one at Crystal Falls, two at Vulcan, all of these being underground; and an open-pit mine close to the town of Iron Mountain. Included in the 13 properties at Iron River is one, the Sherwood, which is being opened "from grass roots" and is being provided with a new plant of striking design. The operating companies number seven—namely, the M. A. Hanna Co., Pickands, Mather & Co., Cleveland-Cliffs Iron Co., Republic Steel Corporation, Pittsburgh Coke & Iron Co., Globe Iron Co. and Inland Steel Co.

Of all the iron ranges in Michigan and Minnesota the Menominee alone ships from a port on Lake Michigan. Two roads, the Chicago & North Western and the Chicago, Milwaukee & St. Paul, serve the mining companies. Complex folding characterizes the features of ore occurrence. The orebodies are much smaller than on the other Michigan ranges and are mostly vertical, though dipping also at all angles. Certain "black" slates containing sulphur occur in the geologic column, and on account of the folding may appear in the hanging wall as well as in the footwall, giving rise to caving and mine fires. Surface overburden often reaches to a depth of 100 to 250 ft. and may be saturated with water.

A picture of current operations and equipment practice is given in the accompanying table. It will be noted that trolley haulage utilizing 250-v. direct current is still in universal use. Ore is handled, moreover, wholly by scrapers, with alternating-current tuggers predominating over direct-current hoists, the latter, when used, being usually where convenient to the trolley line. Some tugger operators and superintendents still favor the direct-current hoist because of the readiness with which it picks up an overload. Others claim that this readiness is too likely to cause a burn-out and that the alternating-current tugger which lies down when overloaded is better. Loading machines are coming strongly into use for handling rock in development headings, supplanting the scraper slides that have hitherto been in vogue for such work. The objections to the slide in headings are that its use makes it difficult or impossible to keep the drainage ditch open, so that water gathers in front of it in a puddle; also that it leaves little space for a man to get by it when going to or coming from the face. The data tabulated also show that the mine water is frequently acid, presenting problems that call for lining pumps and columns. Moreover, the water is often gritty.

To the tabular details it may be

Hiawatha No. 1

Hiawatha No. 2

Homer

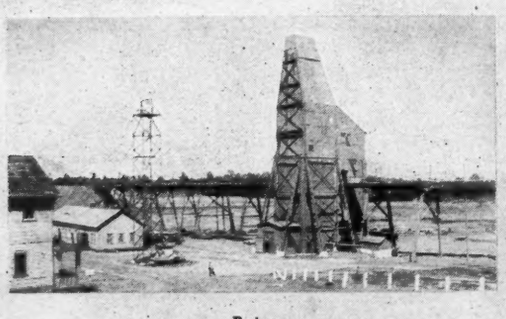
Cardiff shaft

Minkler shaft

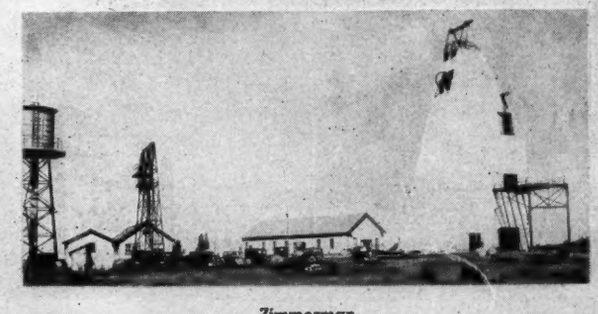
Data on Mining Practice at Iron Mines Operating in 1941

Operating Company and Mines	Production Scheduled for 1941, Tons	Headframe	Shaft	Hoist	Levels	Mining Method
M. A. Hanna Co.						
Hiawatha No. 1	480,000 (including Hiawatha No. 2)	6-post, steel, covered, 110 ft. high to sheave center. Crusher	1,700-ft. deep, vert. Rock section 7 ft. 8 in. by 16 ft. 4 in. 3 compartments, 2 skips, 1 with cage under it, 1 with counterweight underneath. Wood-timbered	Single 10x10-ft. drum geared to 600-hp. synchronous motor. Two 1¼-in. ropes. Hoists from 16th level only	16th only operating level. 17th being driven 165 ft. below. Interval formerly 100 ft., up to 165 ft.	Sublevel stoping. Open stopes
Hiawatha No. 2	See above	4-post, steel, metal-clad, 106 ft. high. Crusher	1,700 ft. deep, vert. Rock section 8x22 ft. 4 compartments, 2 skips, 1 cage, 1 pipe-and-ladderway. Concreted to 12th level, 1,264 ft.	Skip hoist—10x10 ft. drum geared to 600-hp. induction motor. Cage hoist—10x10-ft. drum geared to 300-hp. induction motor	Same as above	Same as above
Zimmerman	Unwatering finished Oct., 1941. Expected to mine 50,000 tons, 1941, 200,000 in 1942	6-post, steel, covered with Transite board, 100 ft. high. Crusher	600 ft. deep, vert. Rock section 14x14 ft. 4 compartments, 2 skips in balance, 1 cage, 1 pipe-and-ladderway. Wood-timbered	Ore hoist—7x8-ft. drum geared to 350-hp. motor. Cage hoist has 7x7-ft. drum geared to 350-hp. motor	5th and 6th levels open now. Will work on 6th. Interval 155 ft.	Sublevel stoping
Bates	180,000	4-post, steel, metal-clad, 105 ft. high to sheave center. Crusher	1,700 ft. deep, vert. Rock section 9¼x16¼ ft. 4 compartments, 2 skips, 1 cage, 1 pipe-and-ladderway. Concreted 130 ft. to ledge. Wood-timbered rest of way	Ore hoist—10x8 ft. drum, 400-hp. motor. Cage hoist—7x9 ft. drum, 250-hp. motor	Using only 16th level. Interval 250 ft. between 14th and 16th. Interval formerly 200	Sublevel stoping
Homer	220,000	4-post, steel, covered, 84 ft. high	900 ft. deep, vert. Rock section, 12x16 ft. 5 compartments, 2 skips, 1 cage, 1 pipe-and-ladderway. Concreted 135 ft. to ledge. Wood-timbered rest of way	Ore hoist—10x8-ft. drum geared to 450-hp. motor. Man hoist 8x7-ft. drum geared to 200-hp. motor	Hoisting only from 8th level, 900-ft. below collar. Level interval 155-ft. Homer connected with Minkler and Cardiff on this level.	Sublevel stoping. A small part is mined by sublevel caving
Minkler (part of Homer)	See above	4-post, steel, metal-clad, 55 ft. high. Built in company's shop	930 ft. deep, vert. Rock sect. 11 ft. 1 in. by 13 ft. 10 in. 5 compartments. 2 skips, 1 cage, 1 counterweight, 1 pipe-and-ladderway. Steel sets all way	Only supplies hoisted. Rock dumped on surface and scraped away. Could hoist ore if new headframe were provided.		
Cardiff (part of Homer)	See above	4-post, steel, metal-covered, 87 ft. high	Down to 1st level only. Rock section, 12x16 ft. 4 compartments			
Pickands, Mather & Co.						
James	303,000	4-post, steel, uncovered, 75 ft. high to sheave center, 90 ft. total height	582 ft. deep, vert. Rock section, 17 ft. 8 in. by 7 ft. 8 in. 4 compartments, 2 skips, 1 cage, 1 pipe-and-ladderway	Skip—single drum geared to 400-hp. ind. motor. Cage—single drum geared to 100-hp. ind. motor	Working from 5th level only. Interval approximately 120 ft.	Sublevel stoping
Bengal	350,000					
No. 1 shaft		4-post with backstay, steel, 104 ft. high to sheave center	727 ft. deep, vert. Rock section 17 ft. 8 in. by 7 ft. 8 in. 3 compartments, 2 skips, 1 ladderway. Wood sets except 1 lift with steel sets	Ore hoisted in this shaft. Single 6x6-ft. drum, 225-hp. motor.	Hoisting from 4th and 5th levels. Interval 150 ft.	Top slicing
No. 2 shaft		4-post, steel, battered, 40 ft. high to center of sheave	686 ft. deep, vert. Rock section 10 ft. 10 in. by 9 ft. 10 in.	Cage only. Single 5x7-ft. drum, 150-hp. motor		
Buck (This and Baltic and Fogarty mines on second page following are operated as one property)	400,000	No shaft. Ore from 3 properties hoisted through Baltic shaft, men and supplies through Fogarty				Top slicing and sublevel caving

(Table continued on second page following)



Bates



Zimmerman

Hanna shops (Rogers mine)

Sherwood

James

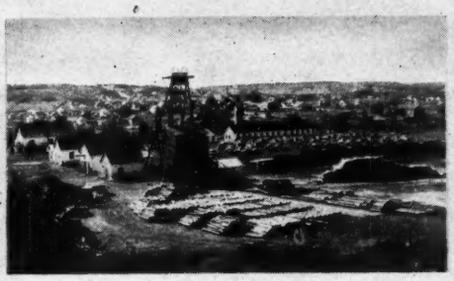
on Menominee Range in the Lake Superior Iron Country

Haulage System Mine Cars	Scrapers	Loading Machines	Drills	Steel, Bits	Drainage
Trolley haulage 250 v., d.c. Cars, 60 cu. ft., steel, side-dump, ball-bearing, 36-in. gage. Dump by air jack into skip	Both 240 v., a.c., and 250 v., d.c.; latter when near trolley line. Tuggers, 10-, 15-, and 25-hp. double-drum. Box-type, 36 to 48 in. wide	One Eimco Model 21 for development drifts only	Wet. Jackhammers, stopers, and mounted 3- and 3½-in. drifters. Two automatic-feed machines included	Detachable bits only, including No. 1 Timken and No. 1 Jackbits. 2¼-in. is only size bought. ⅞-in. hollow hex., 1¼-in. hollow rd., 1-in. quarter-oct.	400 g. p. m., acid. Motor-driven plunger pumps, concrete-lined cylinders, rubber-lined discharge line and connections, stainless steel poles
Same as above	Same as above	Same as above	Same as above	Same as above	Same as above
Same as above except that cars are 50 cu. ft. capacity	Will use 15-hp., a.c. tuggers. Box-type scrapers, 30, 36 and 42 in. wide	Same as above	Wet. Auger drilling in ore. Jackhammers and 3-in. mounted drifters in country rock (iron formation)	Diamond-section steel for augers. Jackbits used in country rock	350 g. p. m. (shut down since 1931). Motor-driven plunger pumps. Centrifugals for standby. Water slightly acid
Same as at Zimmerman. Cars of 50 cu. ft. capacity	Both a.c. and d.c., latter when convenient to trolley line. Tuggers 10- and 25-hp. Box-type, 36, 42, and 48 in. wide	None	Wet. Jackhammers and 3½-in. mounted drifters	Rods and jackbits, 2¼-in. starter only bought. Five regrinds here and at other Hanna mines	450 g. p. m., not acid, from workings. Plunger pumps, centrifugal standbys. Also 800 g. p. m. surface water with Layne & Bowler deep-well pumps
Same as at Zimmerman and Bates	Both a.c. and d.c., latter where convenient to trolley line. Tuggers 10-, 15-, and 25-hp. Box-type, 30, 36, 42, and 48 in. wide	None (two scraper slides for drifting)	Wet. Jackhammers, some mounted with jackleg; some unmounted	Detachable bits and ⅞-in. quarter-octagon steel. Start with 2½-in. size	3,000 g. p. m. from workings including Minkler (400 g. p. m.) and Cardiff (1,500 g. p. m.) shafts. Plunger pumps, centrifugal standbys. Also 3,650 g. p. m. of surface water from 100 to 227 ft. depth with Layne & Bowler deep-well pumps
Trolley haulage, 250-v., d.c. Three-ton rigid-body rotary-dump steel cars.	d.c. tuggers, driven by 25-hp. motors. Mostly 2-drum, some 3-drum. Hoe-type scraper 4 to 5 ft. wide	One Eimco Model 21, for development drifts only	Development, jackhammers, ⅞-in. hex., steel. Mining, 3-in. drifters, 1¼-in. hol. rd. steel	Detachable bits, Timken, 2¼- to 1⅛-in. side hole for all work	175 g. p. m., all from bottom, not acid. Horizontal plunger pumps unlined
Trolley haulage, 250-v., d.c. Three-ton (52-cu. ft.) rocker-dump steel cars	Tuggers, a.c., double-drum, 25-hp. motors. Hoe-type, 48 in. wide	One Eimco Model 21, for development work only	Jackhammers for all work, ⅞-in. hol. hex. steel	Detachable bits, 2-in. to 1⅛-in., side-hole for all work	375 g. p. m., single lift from bottom level. One horizontal plunger pump, unlined, centrifugal standby
(The Buck, Baltic, and Fogarty are operated as one mine. See other two)	Tuggers, a.c., double-drum. 25-hp. motors. Hoe-type scrapers, 48 in. wide	One Eimco Model 21, for development only. Serves also Fogarty and Baltic	For mining, jackhammers, heavy L-section auger steel. See next column for development	For development, ⅞-in. hol. hex. steel, 2¼-to 1⅛-in. detachable bits, side hole	See item at top of column on second page following

Bengal

added that a forced ventilation system is commonly provided in the mines on the Menominee, involving use of a large fan on the surface and of small blowers underground, one for each working place. All possible precautions against dust disease are taken. Workings in general are untimbered save for chutes. Electric cap lamps are

Buck



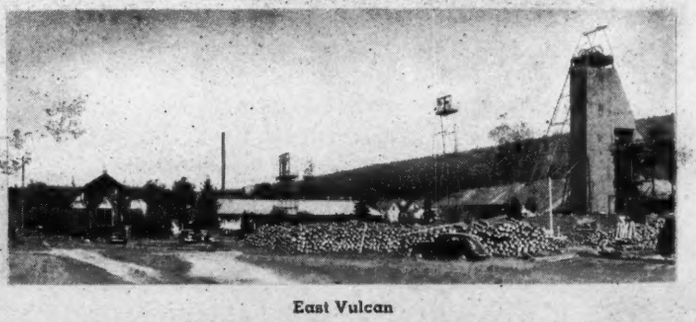
Fogarty shaft

At Davidson No. 3

Data on Mining Practice at Iron Mines Operating in 1941

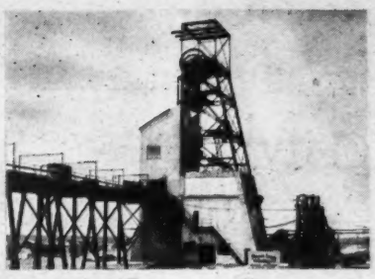
Operating Company and Mines	Production Scheduled for 1941, Tons	Headframe	Shaft	Hoist	Levels	Mining Method
Baltic	See Buck	4-post, steel, with backstay, covered, 103 ft. high to sheave center	933 ft. deep to 10th level. Rock section 17 ft. 8 in. by 7 ft. 8 in., 3 compartments, 2 skips, 1 ladderway	Single 6½x6-ft. drum, geared to 30 hp. ind. motor. Ore hoisted through this shaft	9th level deepest worked. 10th level being driven 150 ft. below	Sublevel stoping
Fogarty	See Buck	A-frame, steel, uncovered, 62 ft. to sheave center	900 ft. deep to 10th level. Rock section 7 ft. 8 in. by 17 ft. 8 in., 3 compartments, 2 cages, 1 ladderway	Single 6x6-ft. drum, geared to 200-hp. ind. motor. Men and supplies hoisted in this shaft		Top slicing
Penn Iron Mining Co. (Pickands, Mather & Co.) East Vulcan	600,000 Grade Iron 58.73% (wet) P 0.061% SiO_2 9.000% H_2O 7.300%	4-post, steel, with backstay, covered. Over-all height 115 ft. 9 in.	1234 ft. deep. Rock, section 12x16 ft. 4 compartments, 2 skips, 1 cage, 1 pipe-and-ladderway	Skip hoist—single 10 x10-ft. drum geared to 450-hp. motor. Balanced skips. Cage hoist—10x10-ft. drum geared to 300-hp. motor, handles cage and counterweight	Two operating levels, deepest 1,185-ft. Interval 150-ft.	Sublevel caving
West Vulcan Curry shaft	275,000 Grade Iron 57.63% P 0.53% SiO_2 9.50% H_2O 6.50%	4-post, steel, concrete-reinforced. Total height 104 ft.	2,004 ft. deep, 3 compartments. Rock section 7½x16 ft. down to 1,426 ft. with wood sets; 8x15 ft. from 1,426 to 1,813 ft., with steel sets; and 6½x15 ft. the rest of the way with steel sets,	Two 7x5½-ft. clutched drums, geared to 350-hp. induction motor	One operating level 1,962-ft. below collar. One level under development. Interval 150 ft.	Sublevel caving
Brier Hill shaft		6-post, steel, total height 116 ft.	1,929 ft. deep, 4 compartments. Steel sets all the way. Concrete-lined to 1,506 ft.	Two 12x5-ft. 9 in. drums with conical counterbalance. Driven by 450-hp. induction motor through rope and gear reducer		
Inland Steel Co. Sherwood	Newly opened	10-post, steel, covered. Total height 135 ft. Crusher	Rock section 13x16 ft. Two skips, one cage, one ladderway		Two levels to be opened at 400 ft. and 1000 ft.	Sublevel stoping
Republic Steel Corp. Tobin	300,000 High-phosphorus ore	4-post, steel, metal-clad, 104 ft. 2 in. high to sheave center. Stock-pile trestle 35 ft. and crusher platform 62 ft. above collar	1,783 ft. deep. Rock section 23x7½ ft., 4 compartments, timbered with wood sets and lath. Concreted to ledge 38 ft.	Cage hoist—single 9-ft. dia. drum geared to 175-hp. induction motor. Ore hoist—single 9ft. dia. drum geared to 500-hp. ind. motor	Deepest level 15th. One operating level. Interval 200 ft.	Sublevel stoping
Pittsburgh Coke & Iron Co. Davidson Ore Mining Div. Davidson No. 1	500 (daily) Foundry grade	8-post, wood, 70 ft. high. Soon to be replaced with steel structure	700 ft. deep, 4-compartment, wood sets. Concreted 15 ft. below collar	Single 7-ft. dia. by 6-ft. drum, geared to 200-hp. induction motor	One operating level. Deepest level 650-ft. Interval 100-ft.	Sublevel caving
Davidson No. 2	400 (daily) Foundry grade	8-post, wood, 65 ft. high. Soon to be replaced with steel structure	440 ft. deep, 3-compartments. Timbered with wood. Unlined	Single 5x5-ft. drum, geared to 100-hp. induction motor	One operating level. Deepest level 440-ft. Interval 100-ft.	Sublevel stoping. Some top slicing
Davidson No 3	300 (daily) Foundry grade	4-post, steel, 50 ft. high	560 ft. deep, 3 compartments. Wood sets, wood-lined	Single 5x5-ft. drum geared to 100-hp. induction motor	Two operating levels. Deepest level 535 ft. Interval 135 ft.	Sublevel stoping
Cleveland-Cliffs Iron Co. Spies-Virgil	168,000	10-post, steel, partly covered, 115 ft. high. No. 7½ gyratory	1,250 ft. deep. Rock section 15x15 ft., 4 compartments, 2 skips, 1 cage, 1 ladderway. Wood-timbered	Single 10-ft. dia. by 7-ft. drum geared to 400-hp. induction motor. Skip and cage in balance	Two operating levels. Deepest level 1,200-ft. Interval 250-ft.	Sublevel stoping
OPEN-PIT MINING **Globe Iron Co.**	60,000 (approximate output, 1941)	The mine is the only open pit in operation on the Menominee. A low-phos ore and a high-phos. ore are mined separately and mixed. Equipment: a 1½-cu. yd. full-revolving electric shovel; 4, 1½-ton trucks, and 1 electric churn drill for 6-in. holes. Ore crushed to 4 in. in gyratory and shipped				

Spies-Virgil

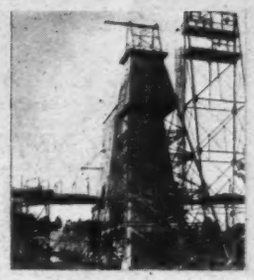


East Vulcan

Brier Hill shaft



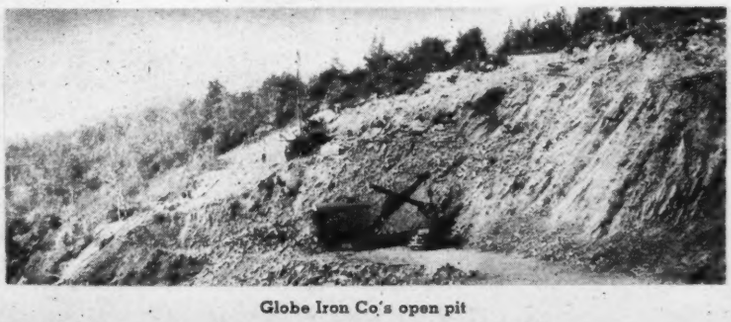
Curry shaft



Tobin

on Menominee Range in the Lake Superior Iron Country

Haulage System Mine Cars	Scrapers	Loading Machines	Drills	Steel, Bits	Drainage
Trolley haulage, 250-v., d.c. Three-ton (52-cu. ft.) rocker-dump steel cars	Same as Buck	See Buck			415 g. p. m., not acid. Three vertical, triplex plunger pumps. Grit settled out
See Buck	See Buck	See Buck			See above
Trolley haulage, 250-v., d.c. Rocker-dump steel cars, 65-cu. ft.	38 a.c. tuggers, 15- and 30-hp. Also 4 d.c. tuggers, 15-hp. Hoe-type scrapers, 42 to 60 in. wide	One Eimco loader, on development only	Wet. Hand-held jackhammers, stopers, mounted drifters. Last most used. Auger steel with jackhammers for soft ore	Detachable bits with 1-in. quarter-octagon and 1¼-in. hollow-round steel used. Bits bought in 2¼- and 2½-in. sizes, 75% being end hole and 25% side hole	600 g. p. m. Not acid. Grit settled out. 12th level—one single-stage centrifugal, 800 g.p.m. 10th level—900 g.p.m. Hor. plunger pump and one 1,000 g.p.m. centrifugal
Trolley haulage, 250-v., d.c. Rocker-dump steel cars, 55 cu. ft. Also 75-cu. ft. lowhead, side-dump steel cars	a.c. tuggers, 15 to 50-hp. Hoe-type scrapers, 42 to 60 in. wide	Two Eimco loaders used in development work only	Wet. Hand-held jackhammers, stopers, and mounted drifters. For soft ore auger steel is used with hand-held machines. In general, mounted drifters with 1-in. quarter-octagon and 1¼-in. hollow-round steel with detachable bits are used. For development a 5-machine drill rig is used	Detachable bits purchased are 2¼ and 2½-in. in size; 75% end hole and 25% side hole	1,100 g. p. m., no acid. On the 22d level—3 Hydracone centrifugal pumps, 1,100 g. p. m. capacity at 429 ft. lift to 19th level pump station. Also 2 deep-well turbine pumps, 1,800 g. p. m. capacity, delivering to centrifugal. On the 19th level—4 duplex double-acting, horizontal plunger pumps. Capacity 650 g. p. m. each at 1,491 ft. lift. All pumps unlined
Trolley haulage, 250-v., d.c. Rotary-dump 60-cu. ft. steel cars	d.c. tuggers, 6½-to 20-hp. Hoe-type scrapers 36 to 48 in. wide	None	Wet. 3-in. post-mounted drifters, automatic feed stopers, hand-held jackhammers	All steel hollow; ⅞-in. hex., ¾-in. oct., 1-in. hex., and 1¼-in. round. Detachable bits 2¼ and 2½-in. sizes, end and side holes with rods. Also conventional steel	300 g. p. m. Horizontal and vertical triplex. Maximum lift, 1,300 ft. Unlined
Trolley haulage, 250-v.. d.c., with 4-ton motors. Three-ton steel cars	90% of tuggers are a.c. Motors 7½ to 15 hp. Box-type scrapers, 36 in. wide	None	Wet. Drifters, stopers, and hand-held jackhammers	Detachable bits, both side- and end-hole, mostly latter	150 g. p. m. Water is acid. Lime used to reduce wear. Centrifugal pump
Trolley haulage, 250-v., d.c., with 2½-ton steel cars	a.c. tuggers, 7½-to 15-hp. Box-type scrapers, 36 in. wide	None	Same as above	Detachable bits, 2½-in. maximum diameter	30 g. p. m. Acid water. Centrifugal, unlined, 460 ft. maximum lift
Trolley haulage, 250-v., d.c., with 2½-ton steel and wood cars	Same as above	None	Same as above	Same as above	30 g. p. m. Acid water. Centrifugal, unlined
Trolley haulage, 250-v., d.c. Rocker-dump steel cars, 2½-ton	d.c. tuggers, double-drum 10-, 15-, 20-, and 25-hp. Hoe-type scrapers, 30 to 48 in. wide	None	Hand-held jackhammers with stoper legs, stopers, and drifters. All drilling wet	Some auger steel, also 1-in. and ⅞-in. hollow hex. Detachable bits, including standard and Sibley bits, in sizes 2¼ to 2-in. Mostly side-hole bits	100 g. p. m. Water is strongly acid. Lime used to neutralize. Vert. triplex plunger pumps, unlined. Maximum lift 1,200 ft. 300 g. p. m.



Globe Iron Co.'s open pit

already extensively used but carbide lamps still linger in some mines. Stopes are often floodlighted, as with a 500-watt lamp and a reflector.

Ore beneficiation on the Menominee is limited to crushing. Of the 1940 tonnage, 1,378,861 tons, or approximately half, was so treated.

Domestic Manganese From Butte Helps in Emergency

Anaconda's recently completed plant is producing concentrates of ferro grade from Emma ore by flotation and nodulizing

John B. Huttl
Assistant Editor

ANNUAL REQUIREMENT of manganese ore or concentrate of ferromanganese grade in the United States is around 1,250,000 tons. Before the present emergency the bulk of the required tonnage was imported from the U.S.S.R., Africa, India, Brazil, and Cuba, with domestic producers, principally those operating in the Philipsburg and Butte mining areas of Montana, contributing occasionally a small share of high-grade material. The large, low-grade manganese deposits available in the United States did not receive serious attention for the most part until the outbreak of the present war in Europe.

Manganese ores of this character constitute a peculiarly subtle problem from the ore-dressing viewpoint. Attempts made in the past to convert low-grade manganese ore into an acceptable product disclosed that though in some cases the log washer, jig, and table have been successful in producing concentrate of ferromanganese grade, simple methods in general have been inapplicable. In tackling the problem of beneficiating large tonnages of low-grade ore available in the Emma mine, at Butte, Anaconda Copper Mining Co., in making use of relatively simple methods, has succeeded in producing a manganese product of excellent grade. On July 7, 1941, the company placed in operation at the reduction works in Anaconda a plant that is turning out a product suitable for making ferromanganese on a large scale. The Emma ore assays about 21 percent manganese, which occurs chiefly as the mineral rhodochrosite in a siliceous gangue.

At the new plant the mine-run ore is concentrated from an average grade of 21 percent to a flotation concentrate containing from 38 to 40 percent manganese. This product is treated in a rotary kiln to eliminate CO_2 and nodulize it. The minus-6-in. plus-20-mesh material containing 58 to 62 percent manganese resulting from this operation is a product that is excellent physically and in its manganese content.

Treatment involves crushing to minus $\frac{1}{4}$ in. in three stages, with closed-circuit screening, grinding to minus 65 mesh, removal of zinc sulphides by flotation, soap flotation for recovering manganese, and nodulizing the manganese concentrates in a large, rotary kiln, whence they are discharged minus the contained CO_2. Flotation and nodulizing are carried out in separate buildings, the crushing and grinding first being done at the copper concentrator. Here advantage has been taken of available crushing, screening, and grinding machinery. All plants are connected by an efficient pipe system through which the materials are directed to respective treatment units by pumps or, where possible, by gravity. The capacity of the treatment plant is 1,000 tons of ore per day, the production of nodules from the concentrate running at the rate of 100,000 tons per year.

Fig. 1 illustrates the method of treating the raw ore at the copper concentrator and the flotation plant, and size and type of equipment used. Ore is withdrawn from the coarse-ore bin by two pan feeders dumping onto two shaking feeders with 2-in. holes. The oversize goes to a jaw crusher, and the undersize direct to the boots of two bucket elevators discharging over two vibrating screens. The primary crusher product is further reduced in two secondary jaw crushers before being elevated to the screens. Soda ash is added to the elevator buckets. The plus-$\frac{3}{4}$-in. and minus-$\frac{3}{4}$-in. plus-$\frac{1}{4}$-in. screen oversizes are recrushed in two sets of rolls in closed circuit with the screens, and the minus-$\frac{1}{4}$-in. undersize is delivered to a settling tank.

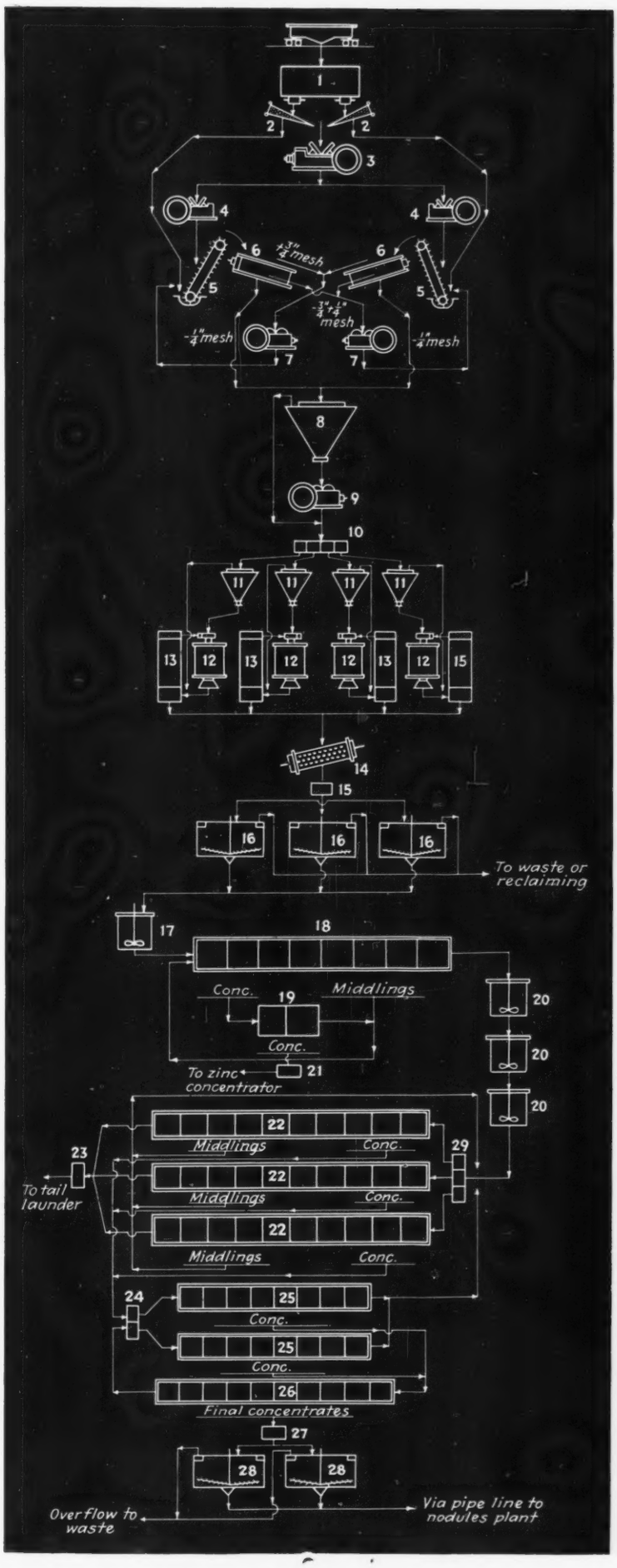
The overflow and the product of the rolls crushing the underflow are distributed to four cone classifiers that feed the underflow to four ball mills in closed circuit with rake classifiers. These grind the material to minus 65 mesh. The cone overflow goes to the classifiers. Overflow from the rake classifiers goes through a trommel chip screen to three thickeners in the flotation building, which thicken the pulp from 35 to 40 percent solids before it enters the sulphide flotation section of the plant.

A conditioner tank, to which are added soda ash, $CuSO_4$, xanthate, and pine oil, an eight-cell rougher flotation machine, and a two-cell cleaner unit are available for removing zinc sulphides from the thickened pulp. Middlings from the rougher machine and tailings from the cleaner cells are returned to the head of the rougher unit. Finished concentrates produced by the cleaner are pumped to the zinc concentrator.

The rougher tailings, which constitute the feed for the soap-flotation section, flow first to three conditioning tanks receiving sodium silicate and soap solution, subsequently to be treated in three ten-cell rougher machines, two eight-cell cleaners, and one ten-cell recleaner unit. Manganese concentrates from the roughers go to the two cleaners, middlings are returned to the heads of the rougher units, and rougher tailings pass to the launder leading to the tailings pond. Concentrates produced by the two cleaners receive final treatment in the recleaner machine. The tailings return to the heads of the roughers. Finished manganese concentrates from the recleaner are thickened to about 65 percent solids in two thickeners, with recleaner tailings going back to the heads of the cleaners.

The overflow from the five thickeners mentioned previously in general goes to waste. All sand and sludge pumps handling the various flotation products are situated in a concrete pit between the six flotation units, with control equipment near by. Reagents are directed to the different tanks and flotation machines from a central feeder plant on an elevated platform, upon which is also installed the unit producing soap solution. Liquid and solid reagents are stored in a large room partitioned off at one end of the flotation building. Here, pumps and mechanical conveying equipment facilitate quick and safe handling of the materials. Machinery in the building is so arranged as to make the necessary supervision possible with only a few men.

The nodulizing plant, which has a



capacity of more than 300 tons per day, is near the flotation building. Operations here resemble those found in a cement plant employing the wet process. Transfer of the manganese concentrates from the flotation building to the two slurry tanks at the head of the kiln is through a pipe line, and the subsequent operations are shown in a self-explanatory manner in Fig. 2 on page 58.

Concentrates prepared in the slurry tanks after passing successively through the feed units shown enter a 270-ft. rotary kiln powered by a 12.5-hp. motor revolving at 1 r.p.m. At the discharge end there are three burners using natural gas and hot air drawn from a pan cooler by a fan. Temperature in the sintering zone is about 2,550 deg. F. Nodules discharged are cooled in the pan cooler mentioned previously, which in turn discharges to a steel grizzly, with 6-in. spacing. Oversize is broken up by hand, and undersize material goes either via a grate cooler to a bucket elevator, or is sent direct to this elevator by means of a bypass chute if desired. The elevator discharges the material to a chute, which delivers it to a 400-ton storage bin. A bucket sampler in a chain passes through the stream every 30 minutes, the sample being passed to a small storage bin.

Products of combustion leaving at the feed end of the kiln pass to a dust chamber, the gases being treated in a Multiclone. Gases, withdrawn from this unit by a fan, are released to the atmosphere through a steel stack. The dust in turn is transported by a screw-conveyor system to a bucket elevator which discharges into a bin, and from this point it is fed back into the

Fig. 1 . . . Flowsheet of the treatment given the rhodochrosite ore from the Emma mine in the concentration and flotation plant at Anaconda

LEGEND

1. Coarse-ore bin
2. Two shaking feeders
3. 12x24-in. jaw crusher
4. Two 8x20-in. jaw crushers
5. Bucket elevators (8x16-in. buckets)
6. Two 4x8-ft. vibrating screens
7. Two 55x24-in. rolls
8. Settling tank
9. 55x24-in. rolls
10. Four-way distributor
11. Four 5-ft. Allen cone classifiers
12. Four P & M ball mills
13. Four 5-ft. DSFX Dorr classifiers
14. Revolving trommel chip screen
15. Automatic sampler
16. Three 50x12-ft. Dorr thickeners
17. 6x8-ft. conditioner tank
18. Eight-cell, 66-in. Fagergren flotation machine
19. Two-cell, 66-in. Fagergren flotation machine
20. Three 6x8-ft. conditioner tanks
21. Automatic sampler
22. Three 10-cell, 66-in. Fagergren flotation machines
23. Automatic sampler
24. Two-way distributor
25. Two 8-cell, 66-in. Fagergren flotation machines
26. 16-cell, 66-in. Fagergren flotation machine
27. Automatic sampler
28. Two 50x12-ft. Dorr thickeners
29. Three-way distributor

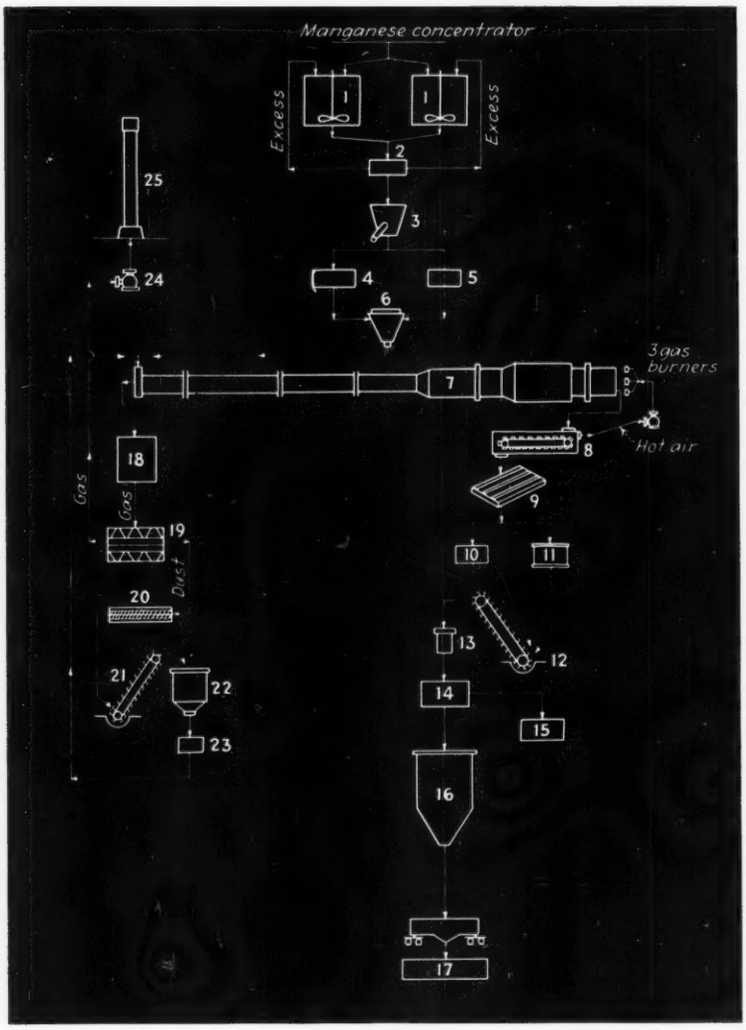


Fig. 2 . . . Flotation concentrates are nodulized in a separate plant according to this flowsheet

LEGEND

1. Two 35x15-ft. slurry tanks
2. Feeder
3. Swing spout
4. Slurry trap
5. Central bucket
6. Feed funnel
7. 270-ft. rotary kiln
8. Pan cooler
9. Steel grizzly
10. Bypass chute
11. Grate cooler
12. Elevator
13. Chute
14. Chain-and-bucket sampler
15. Sample bin
16. 400-ton nodule bin
17. Track scale
18. Dust chamber
19. Multiclone
20. Screw conveyor
21. Elevator
22. Bin
23. Feeder
24. Fan
25. Steel stack

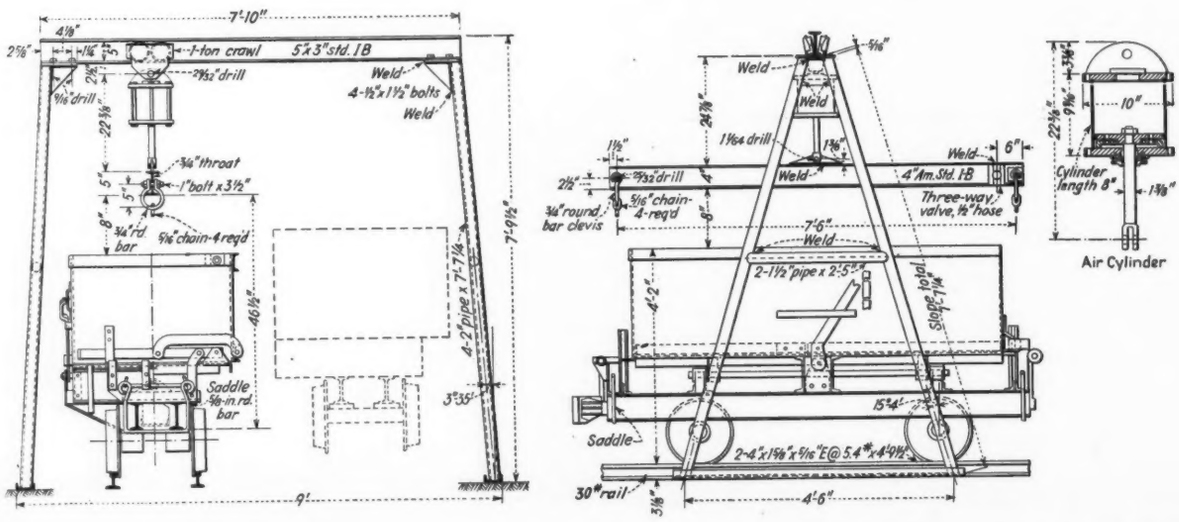
nodulizing kiln for recovery of the valuable material.

Grateful acknowledgment is made to C. A. Lemmon, assistant manager; E. A. Barnard, general superintendent; S. S. Rodgers, superintendent of concentration; and C. P. Donahoe, assistant superintendent of concentration, for the information contained in this article, and for the many courtesies which were shown me while visiting the Anaconda plant.

Cherry Picker For Small Tunnels

USED TO ADVANTAGE underground by Silver King Coalition Mines Co., Park City, Utah, is the handy "cherry picker," details of which appear in the accompanying drawing. Designed for small tunnels and long crosscuts, it is light and compact, and one man can easily move it to a new site. It consists of a light steel frame resembling a carpenter's horse, with a 1-ton crawl holding a short air cylinder assembly—the lifting element proper. The frame's A-shaped ends are made of 2-in. steel pipe, reinforced with 1½-in. pipe cross braces, and the top piece supporting the crawl is a 5-in. I-beam. Auxiliaries for lifting a car include a short length of 4-in. I-beam bolted to the lower end of the piston rod, and two saddles made from ⅞-in. round steel suspended from 5/16-in. steel chains attached at each end of the I-beam. Operation is simple: After the car has been spotted underneath, the saddles are slipped over the ends of the chassis, the air cylinders actuated by turning on the three-way valve on the lifting beam, and the car is lifted and then rolled over to one side.

Cherry picker developed by Silver King Coalition Mines Co., Park City, Utah. Drawing and accompanying description were supplied by M. J. Heitzman, manager



CURRENT METAL

Statistics

FORMAL DECLARATION of war against Japan on Dec. 8 and on Germany and Italy on Dec. 11, 1941, following declaration of war of those countries against the United States, brought unified determination to miners and operators throughout the country that domestic metal supplies would be increased to the limit. Operations are being placed on a three-shift basis wherever possible. Production of copper is being increased at the new Morenci unit of the Phelps Dodge Corporation, in Arizona, and Inspiration Consolidated Copper plans to expand facilities 25 percent to produce at the rate of 5,000 tons a month.

War in the Pacific affecting shipments of tin from the Straits Settlements brought complete government control of tin supplies in the United States on December 17. Shipments of lead from Australia may also become more uncertain.

▶ COPPER—The Metal Reserve's contribution of 43,461 tons of copper to total deliveries of 123,168 tons for November served to maintain a fair balance between domestic production and apparent consumption last month. Stocks of duty-free copper increased from 67,260 tons at the end of October to 72,352 tons at the end of November.

Output of refined copper (duty free) in this country during the first eleven months of 1941 totaled 975,727 tons, pointing to a total for the year of about 1,060,000 tons. Production of refined in 1940 was 1,033,710 tons, and in 1939 it was 818,289 tons.

Domestic copper statistics for the months of September and October, in tons, follow:

	Oct.	Nov.
Production:		
Crude	(a) 86,054	84,020
Refined	86,617	84,799
Deliveries, refined:		
Domestic	121,313	123,168
Export	144	.....
Totals	121,457	123,168
Stock at end (b)	67,260	72,352

(a) Corrected. (b) Duty-free copper at refineries, on consignment, and in Exchange warehouses, but not including consumers' stocks at their plants or warehouses.

Estimated copper content of shipments by mills of all kinds and foundries, allowing for normal return of processing scrap, according to the American Bureau of Metal Statistics, in tons:

	1940	1941
January	74,000	124,000
February	65,000	122,000
March	68,000	132,000
April	68,500	134,000
May	71,000	133,000
June	74,000	136,000
July	78,000	135,000
August	89,000	140,000
September	101,000	134,000
October	114,000	137,000
November	106,000	121,000
December	109,000	.....
Total	1,017,500	.....

▶ MANGANESE — Domestic production of manganese ore containing 35 percent or more manganese (natural) during October was 8,600 long tons, against 9,400 tons in September, the Bureau of Mines reports. Shipments during October totaled 8,500 tons, against 9,400 tons in the month previous. The rate of shipments during 1940 was 3,344 tons a month.

▶ LEAD—Statistics covering lead refined in this country for the months of October and November, in tons, according to the American Bureau of Metal Statistics, follow:

	Oct.	Nov.
Stock at beginning	13,148	10,735
Production:		
From domestic ore	37,221	41,566
Secondary and foreign	3,906	7,364
Totals	41,127	48,930
Domestic shipments	43,537	45,980
Stock at end	10,735	13,671

▶ TIN—World stocks of tin, including smelters' stocks and carry-overs, increased 4,736 long tons during October to 51,465 tons. A year previous the stocks totaled 63,890 tons.

▶ SILVER—Production of silver in the United States (refinery output) was 5,087,000 oz. during October, according to the American Bureau of Metal Statistics. This brings the total for the first ten months of 1941 to 58,836,000 oz.

▶ CADMIUM—Consumption of cadmium in the United States in 1940, by industries in pounds of contained cadmium, according to the Bureau of Mines:

Industry	Pounds
Electroplating	3,341,000
Bearing alloys	1,334,000
Copper alloys	204,000
Solder	73,000
Zinc alloys	36,000
Low-melting alloys	23,000
Other metal and alloys (a)	18,000
Unclassified metal and alloys (b)	317,000
Total, metal and alloys	5,346,000
Paints and lacquers	293,000
Ceramics	256,000
Printing inks	88,000
Chemical reagents	44,000
Rubber	35,000
Paper	17,000
Leather	10,000
Textiles	4,000
Other pigments and chemicals (c)	11,000
Unclassified pigments and chemicals	74,000
Total, pigments and chemicals	832,000
Total cadmium	6,178,000

(a) Includes graphite impregnations, silver alloys, powdered metal, type metal, etc. (b) Presumably mostly electroplating. (c) Includes photographic papers, crayons, plastics, linoleum, etc.

▶ MOLYBDENUM—Production of molybdenum concentrate (molybdenum content) during October was 3,918,900 lb., which compares with 3,816,600 lb. in September. Shipments during October totaled 4,135,300 lb., of which 1,161,500 was for export. Total shipments during September amounted to 3,093,900 lb., of which 91,100 went for export. Stocks at the mines at the end of October amounted to 18,603,000 lb., against 18,819,400 lb. a month previous, the Bureau of Mines reports.

▶ ZINC—The domestic zinc statistics (all grades) for November and December, according to the American Zinc Institute, follow:

	Nov.	Dec.
Stock at beginning	21,594	23,182
Production	74,951	78,635
Total	96,545	101,817
Production daily rate	2,498	2,537
Shipments:		
Domestic	61,154	65,690
Foreign (drawback duty)	12,209	12,065
Total shipments	73,363	77,755
Unfilled orders	79,301	87,666
Stock at end	23,182	24,062

Production of Prime Western and other grades, follows:

Production by Grades		
Prime Western	29,672	31,005
Select	1,417	1,495
Brass Special	4,364	4,677
Intermediate	4,695	5,131
High Grade	16,399	17,787
Special High Grade	18,404	18,540
Total	76,156	78,635

▶ NICKEL—World nickel production and consumption in 1941 were at an all-time high, according to Robert C. Stanley, chairman and president of the International Nickel Co. The joint British, Canadian, and United States war effort required nickel production far beyond anything experienced in the past.

In reviewing the nickel situation, Mr. Stanley said:

The United States consumed more than two-thirds of the world's total nickel output in 1941, as contrasted with an average annual consumption of about one-third during recent years. It is estimated that steel mills in the United States are currently consuming approximately 70 percent of the refined nickel imported into that country. Of the remaining 30 percent, foundries are taking 7.3 percent, brass mills 6.5 percent, heat-resisting and electrical-resistance alloys 4.6 percent, electroplaters 2.5 percent, and the balance is required for rolled nickel and high nickel alloys and a variety of other products.

All mines and smelters of International Nickel operated at capacity throughout the year and the production rate has been raised in an endeavor to satisfy the unprecedented war-time demands for nickel. To increase its nickel production by 50,000,000 lb. annually over its 1940 rate, the company has undertaken a production expansion program, to be completed in 1943, involving $35,000,000.

In September, 1941, the British Ministry of Supply renewed for another year International Nickel's agreement to deliver the major part of its output of electrolytic copper for war requirements of the United Kingdom, and all of the remainder will be sold in Canada.

The price of nickel in Canada and the United States remained unchanged during 1941. No price revision is anticipated in the immediate future.

Summary of the

MARKETS

WAR with Japan and the Axis has disrupted shipping schedules, particularly in the Far East, and halted all trading in tin. In copper, lead, and zinc, as well as minor metals of strategic importance, the war served to stimulate production, with operations going on a seven-day basis to speed output. With prices in nearly all instances under Government control, the market for non-ferrous metals during December was devoid of excitement on that score. Quicksilver has moved upward and foreign silver held to the modest advance announced late in the preceding month. Control of imports of 13 strategic minerals was announced on Dec. 28, the list including copper, lead, zinc, quicksilver, tungsten, vanadium, and antimony. Control of tin stocks became effective Dec. 17 and consumption of the metal was curtailed sharply.

A higher average for foreign silver was largely responsible for raising the E&MJ price index from 84.32 in November to 84.42 in December.

Domestic consumption of copper during November was 121,000 tons, according to the American Bureau of Metal Statistics, making the total for the first eleven months 1,448,000 tons. The Bureau's estimate of consumption is based on copper content of shipments by mills and foundries. Meetings were held in Washington to consider production. The question of copper prices was discussed and again Price Administrator Henderson made it clear that the Government's attitude on the 12c. basis for the bulk of this country's output will be continued. Metals Reserve will pay more for Latin-American copper in renewing its deal, probably close to the 12c. Valley basis, the industry believes.

The lead situation comes up for review early in January and the industry hopes for a more liberal price policy to raise output. Metals Reserve purchased foreign lead for first quarter delivery at 4c. a pound, f.o.b. United States ports, an advance of one-quarter cent. The domestic market during December continued at 5.85c., New York. Domestic producers will set aside 15 percent of production for the January reserve pool.

Emergency pool needs for January in zinc were set at 31 percent of October production.

UNITED STATES MARKET

1941	Electrolytic Copper: Domestic (a) Refinery	Electrolytic Copper: Export (b) Refinery	Straits Tin: New York	Lead: New York	Lead: St. Louis	Zinc: St. Louis
Dec.						
1	11.775	11.200	52.000	5.85	5.70	8.25
2	11.775	11.200	52.000	5.85	5.70	8.25
3	11.775	11.200	52.000	5.85	5.70	8.25
4	11.775	11.200	52.000	5.85	5.70	8.25
5	11.775	11.200	52.000	5.85	5.70	8.25
6	11.775	11.200	52.000	5.85	5.70	8.25
8	11.775	11.200	52.000	5.85	5.70	8.25
9	11.775	11.200	52.000	5.85	5.70	8.25
10	11.775	11.200	52.000	5.85	5.70	8.25
11	11.775	11.200	52.000	5.85	5.70	8.25
12	11.775	11.200	52.000	5.85	5.70	8.25
13	11.775	11.200	52.000	5.85	5.70	8.25
15	11.775	11.200	52.000	5.85	5.70	8.25
16	11.775	11.200	52.000	5.85	5.70	8.25
17	11.775	11.200	52.000	5.85	5.70	8.25
18	11.775	11.200	52.000	5.85	5.70	8.25
19	11.775	11.200	52.000	5.85	5.70	8.25
20	11.775	11.200	52.000	5.85	5.70	8.25
22	11.775	11.200	52.000	5.85	5.70	8.25
23	11.775	11.200	52.000	5.85	5.70	8.25
24	11.775	11.200	52.000	5.85	5.70	8.25
25	Holiday					
26	11.775	11.200	52.000	5.85	5.70	8.25
27	11.775	11.200	52.000	5.85	5.70	8.25
29	11.775	11.200	52.000	5.85	5.70	8.25
30	11.775	11.200	52.000	5.85	5.70	8.25
31	11.775	11.200	52.000	5.85	5.70	8.25
	AVERAGES FOR MONTH					
Dec.	**11.775**	11.200	52.000	5.850	**5.700**	8.250
Dec.	**AVERAGES FOR WEEK**					
3	11.775	11.200	52.000	5.850	5.700	8.250
10	11.775	11.200	52.000	5.850	5.700	8.250
17	11.775	11.200	52.000	5.850	5.700	8.250
24	11.775	11.200	52.000	5.850	5.700	8.250
31	11.775	11.200	52.000	5.850	5.700	8.250
Dec.	**CALENDAR WEEK AVERAGES**					
6	11.775	11.200	52.000	5.850	5.700	8.250
13	11.775	11.200	52.000	5.850	5.700	8.250
20	11.775	11.200	52.000	5.850	5.700	8.250
27	11.775	11.200	52.000	5.850	5.700	8.250

SILVER, GOLD AND STERLING EXCHANGE

1941	Sterling Exchange: "Checks" (Nominal)	Sterling Exchange: "90-day demand"	Silver (c): New York	Silver (c): London	Gold: London	Gold (d): United States
Dec.						
1	401.000	(f)	35.125	23.500	168s	$35.00
2	401.000	(f)	35.125	23.500	168s	35.00
3	401.000	(f)	35.125	23.500	168s	35.00
4	401.000	(f)	35.125	23.500	168s	35.00
5	401.000	(f)	35.125	23.500	168s	35.00
6	401.000	(f)	(e)	(e)	(e)	35.00
8	401.000	(f)	35.125	23.500	168s	35.00
9	401.000	(f)	35.125	23.500	168s	35.00
10	401.000	(f)	35.125	23.500	168s	35.00
11	401.000	(f)	35.125	23.500	168s	35.00
12	401.000	(f)	35.125	23.500	168s	35.00
13	401.000	(f)	(e)	(e)	(e)	35.00
15	401.000	(f)	35.125	23.500	168s	35.00
16	401.000	(f)	35.125	23.500	168s	35.00
17	401.000	(f)	35.125	23.500	168s	35.00
18	401.000	(f)	35.125	23.500	168s	35.00
19	401.000	(f)	35.125	23.500	168s	35.00
20	401.000	(f)	(e)	(e)	(e)	35.00
22	401.000	(f)	35.125	23.500	168s	35.00
23	401.000	(f)	35.125	23.500	168s	35.00
24	401.000	(f)	35.125	23.500	168s	35.00
25	Holiday	Holiday	Holiday	Holiday	Holiday	Holiday
26	401.000	(f)	35.125	23.500	168	35.06
27	401.000	(f)	(e)	(e)	(e)	35.00
29	401.000	(f)	35.125	23.500	168s	35.00
30	401.000	(f)	35.125	23.500	168s	35.00
31	401.000	(f)	35.125	23.500	168s	35.00
	AVERAGE FOR MONTH					
Dec.	401.000	....	35.125	23.500	....	35.00
Dec.	**AVERAGES FOR WEEK**					
3	401.000	....	35.050	....	....	...
10	401.000	....	35.125	....	....	...
17	401.000	....	35.125	....	....	....
24	401.000	....	35.125	....	....	....
31	401.000	....	35.125	....	....	....

Calendar week averages: New York Silver: 6th, 35.1250; 13th, 35.1250; 20th, 35.1250; 27th, 35.1250.

(e) Not quoted (Saturday). (f) No quotations.

THE above quotations for major non-ferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

(a) Net prices at refineries on Atlantic seaboard. To arrive at the delivered New England basis add 0.225c. per pound, the average differential for freight and delivery charges.

(b) Export prices are net at refineries on the Atlantic seaboard and include sales of domestic copper in the foreign market. Owing to the European War and the disruption of normal trade relations, our export copper quotations, since September, 1939, have been based largely on f.a.s. transactions, ex United States ports. To arrive at the f.o.b. refinery quotations deduct .05c. from the f.a.s. basis for lighterage.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingot bars; cathodes are sold at a discount of 0.125c.

Quotations for Zinc are for ordinary Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High Grade Zinc delivered in the East and Middle West in nearly all instances command a premium of 1c per pound over the current market for Prime Western but not less than 1c over the *Engineering and Mining Journal's* average quotation for Prime Western for the previous month.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

(c) Silver other than newly-mined domestic, by Handy & Harman. Under Treasury order of July 6, 1939, the price on domestic newly-mined silver mined subsequent to July 1, 1939, was fixed at 71.11c per troy ounce. Handy & Harman's quotation on newly-mined domestic silver, 999 fine was 70⅝c throughout December.

(d) U. S. Treasury's gold price. Actual payment by the United States Treasury for gold in domestic and imported ore or concentrate is at 99.75 per cent of the price quoted by the Treasury, which at present is equal to $34.9125.

PRICES OF METALS • MISCELLANEOUS QUOTATIONS

LONDON TIN PRICES

Dec. 1941	Tin—Standard—Spot	Tin—Standard—3 months
1	257.750	261.000
2	257.000	260.250
3	257.750	260.750
4	257.250	260.500
5	257.000	260.250
8	259.000	262.000
Average (a)	257.625	.....

(a) Average for six days. Japan's entry into the war disrupted all trading in tin and business on the London Metal Exchange was suspended after Dec. 8, pending developments. Official prices on tin in London are in pounds sterling per long ton.

Standard tin in London, spot, for 1941 averaged 261.137 per long ton. In arriving at that figure, which is based on monthly averages, the December average (six days) was used. The average for 1940 was £256.425 and for 1939 £226.177.

OFFICIAL LONDON PRICES—COPPER, LEAD, ZINC

Following are the maximum prices of copper, lead, and zinc established by the Ministry of Supply for the British market, in effect since Dec. 18, 1939:

	Per £	Long Ton s.	Ton d.
COPPER:			
Electrolytic, high conductivity	62	0	0
Fire refined, high conductivity	62	0	0
Fire refined, high grade	61	10	0
Fire refined, min. 99.7 percent	61	0	0
Fire refined, min. 99.2 percent	60	10	0
Hot rolled black wire rods	65	10	0
LEAD:			
Soft foreign, duty paid	25	0	0
Soft, Empire	25	0	0
English refined	26	10	0
ZINC:			
Foreign (G.o.b.), duty paid	25	15	0
Domestic (G.o.b.)	26	10	0
Prime Western and debased	26	10	0
Refined and electrolytic	27	5	0
Minimum 99.99 percent	28	15	0

Quotations are for metal delivered to the consumer.

E & M J PRICE INDEX

Weighted index of non-ferrous metal prices. The average for the years 1922-1923-1924 equals 100.

1929	110.33	1935	74.66
1930	82.87	1936	73.45
1931	60.20	1937	90.86
1932	48.26	1938	73.67
1933	59.79	1939	77.71
1934	69.59	1940	79.22
1941	83.49		

	1939	1940	1941
January	77.12	80.85	82.48
February	76.89	77.23	82.76
March	77.09	77.94	83.27
April	74.79	77.19	83.48
May	73.61	77.68	83.51
June	73.17	78.85	83.48
July	71.95	76.72	83.60
August	73.88	76.71	83.39
September	83.07	79.40	83.34
October	84.25	82.49	83.84
November	83.80	83.14	84.32
December	82.89	82.42	84.42

CURRENT PRICES — MISCELLANEOUS METALS, ORES, AND NON-METALLIC MINERALS

Quotations cover wholesale lots, prompt shipment, f.o.b. New York, unless otherwise stated

(Jan. 1, 1942)

MISCELLANEOUS METALS

Aluminum, ingot, 99 plus per cent, lb	15c.
Antimony, domestic, spot, lb	14.00c.
Bismuth, ton lots, lb	$1.25
Cadmium, commercial sticks, lb	90c.
Calcium, lb., ton lots 97 @ 98 per cent	$1.25
Chromium, 97 per cent grade, lb	89c.
Cobalt, 97 to 99 per cent, per lb	$1.50
Nickel, electrolytic cathodes, lb	35c.
Magnesium, 99.8 per cent, carloads, lb	27c.
Palladium, troy oz	$24.00
Platinum, (Official quotation) troy oz	$36.00
Quicksilver, flask of 76 lb., 100 flasks or more	$200.60
Radium, mg. radium content	$25.00@$30.00
Selenium, 99.5 per cent, lb	$1.75
Silicon, minimum 97 per cent, spot, lb	16.50c.
Tellurium, lb	$1.75
Thallium, 100 lb. or more, lb	$10.00
Titanium, 96 to 98 per cent, lb	$5.00

METALLIC ORES

Beryllium Ore, f.o.b. mines, ton	$30.00@$35.00
Chrome Ore, 48 @ 50% Cr_2O_3 c.i.f. Atl. ports, long ton	(b)$45.00@$47.00
Iron Ore, Lake Superior, Lower Lake ports, long ton:	
Old Range bessemer	$4.75
Mesabi bessemer	$4.60
Old Range non-bessemer	$4.60
Mesabi, non-bessemer	$4.45
Lead (Galena) 80 per cent, Joplin, Mo., ton	$68.64
Manganese Ore, (foreign) c.i.f. U.S. ports, long ton unit of Mn:	
52 @ 55 per cent	(b) 68c.
50 @ 52 per cent	(b) 68c.
46 @ 48 per cent	(b) 63c.
Molybdenum Ore, 90%, per lb. of MoS_2, f.o.b. mines	45c.
Tungsten Ore, per unit of WO_3:	
Chinese, 65 per cent, duty paid	(b) $24.00
Domestic, 65 per cent and upward	(a)$26.00
Vanadium Ore, per lb. of contained V_2O_5	27½c.
Zinc Ore, Prime, 60 per cent concentrate, Joplin, Mo.; per ton	$55.28

(a) Prices at mines, small lots, usually several dollars less. (b) Nominal.

METALLIC COMPOUNDS

Arsenious Oxide (arsenic) lb	4c.
Cobalt Oxide, 70 @ 71 per cent, lb	$1.84
Copper Sulphate, 100 lb	$5.15
Sodium Nitrate, ex vessel, in 200-lb. bags, per 100 lb	$1.43
Sodium Sulphate, bulk, ton	$18.00@$24.00

ALLOYS

Beryllium Copper, master alloy, 2.5 to 3 per cent Be, per lb. of contained Be	$15.00
Ferrochrome, 65 @ 70 per cent chromium, 4 @ 6 per cent carbon, per pound of Cr contained	13c.
Ferromanganese, 78 @ 82 per cent, gross ton	$120.00
Ferromolybdenum 55 @ 65 per cent Mo. lb. of Mo. contained	95c.
Ferrosilicon, 50 percent, gross ton	$74.50
Ferrotungsten, 75 @ 80 per cent, lb. of W contained	$1.90
Ferrovanadium, per lb. of V, delivered	$2.70@$2.90

NON-METALLIC MINERALS

Asbestos, f.o.b. Canadian (Quebec) mines (U.S. funds), ton;	
Crude No. 1	$700@$750
Crude No. 2	$150@$350
Spinning fibers	$110@$200
Paper stock	$40@$49.50
Shorts	$13@$17.50
Vermont, f.o.b. Hyde Park:	
Shingle stock	$57.00@$60.00
Paper stock	$40.00@$48.00
Shorts	$13.00@$26.00
Floats	$18.00
Barytes, long ton:	
Georgia, crude	$8.00
Missouri, 93 per cent $BaSO_4$, less than 1 per cent iron	$6.00@$6.50
Bauxite, long ton:	
Domestic, crude, 50 @ 52 percent (not dried)	$5.00
Domestic, chemical, 55 @ 58 per cent	$7.50@$8.50
Domestic, abrasive, 80 @ 84 per cent	$16.00
China Clay, f.o.b. mines, ton:	
South Carolina and Georgia, No. 1, bulk	$6.75@$8.00
Delaware, No. 1	$14.50
Feldspar, bulk, ton:	
Potash feldspar, 200 mesh	$17.00
Glass-spar, white, 20 mesh	$11.75
Fluorspar, f.o.b. mines, bulk, Kentucky and Illinois 85–5 per cent, all rail movement, ton	$23.00
Ground, 95 @ 98 percent, bulk, ton	$32.00
Lump, acid, 98 percent, bulk, ton	$30.00
Fuller's earth, f.o.b. Georgia or Florida, ton	$7.00@$14.00
Magnesite, per ton:	
Dead-burned, f.o.b. California	$25.00
Dead-burned, f.o.b. Washington	$22.00
Mica, per lb., North Carolina, No. 1 and 2 quality:	
1½ x 2 in.	45@65c.
2 x 2 in.	60@85c.
3 x 3 in.	$1.85@$2.05
3 x 4 in.	$2.15@$2.25
3 x 5 in.	$2.50@$2.75
White, ground, 70 mesh, ton	$60.00@$80.00
Ocher, Georgia, ton	$19.00@$22.00
Pyrites, Spanish, per long ton unit of 8, c.i.f. Atlantic ports	(a) 12c
Silica, in bags, 325 mesh, ton	$20.00@$40.00
Sulphur, Texas, mines, long ton	$16.00
Talc, f.o.b. works, ton:	
New York, double air-floated, 325 mesh	$12.00@$15.00
New Jersey, mineral pulp	$8.50@$10.50
Vermont, extra white, 200 mesh	$9.50@$10.00
Tripoli, Missouri, ton:	
40 mesh, cream colored	$14.50
200 mesh, cream colored	$26.00

(a) Nominal

IRON AND STEEL

Pig Iron, Valley furnaces, gross ton:	
Bessemer	$24.50
Basic	$23.50
No. 2 Foundry	$24.00
Steel, base prices, Pittsburgh:	
Billets, gross ton	$34.00
Structural shapes, 100 lb	$2.10
Bars, 100 lb	$2.15

Monthly and Yearly

AVERAGE PRICES

SILVER AND STERLING EXCHANGE

	New York		London Spot		Sterling Exchange	
	1940	1941	1940	1941	1940	1941
January	34.750	34.750	21.892	23.273	395.442 (a)	402.000
February	34.750	34.750	20.935	23.341	395.652 (a)	401.864
March	34.750	34.750	20.763	23.446	375.212 (a)	401.788
April	34.750	34.750	20.713	23.500	351.817 (a)	401.058
May	34.949	34.750	21.878	23.457	326.452 (a)	400.981
June	34.825	34.750	22.688	23.400	359.560 (a)	401.000
July	34.750	34.750	22.095	23.397	379.750 (a)	401.000
August	34.750	34.750	23.261	23.459	396.889 (a)	401.000
September	34.750	34.750	23.446	23.500	401.646 (a)	401.000
October	34.750	34.750	23.451	23.500	401.692 (a)	401.000
November	34.750	34.772	23.238	23.500	401.783 (a)	401.000
December	34.750	35.125	23.015	23.500	402.000 (a)	401.000
Year	34.773	34.783	22.281	23.439	382.325 (a)	401.224

New York quotations for silver other than newly-mined domestic, cents per ounce troy, 999 fine. London pence per ounce sterling silver 925 fine. Sterling exchange (pound sterling) in cents. (a) Nominal.

COPPER

	F.O.B. Refinery, Electrolytic			
	Domestic		Export	
	1940	1941	1940	1941
January	11.954	11.819	11.999	10.257
February	11.148	11.794	11.471	10.414
March	11.160	11.814	11.407	10.592
April	11.087	11.820	11.258	10.952
May	11.079	11.815	11.191	10.950
June	11.128	11.810	11.216	10.950
July	10.564	11.812	10.189	10.950
August	10.708	11.778	9.851	10.950
September	11.296	11.775	9.849	11.027
October	11.826	11.775	10.436	11.367
November	11.800	11.775	10.084	11.200
December	11.802	11.775	10.293	11.200
Year	11.296	11.797	10.770	10.901

New York quotations, cents per pound.

LEAD

	New York		St. Louis	
	1940	1941	1940	1941
January	5.471	5.500	5.321	5.350
February	5.076	5.602	4.926	5.452
March	5.192	5.765	5.042	5.613
April	5.071	5.850	4.921	5.700
May	5.015	5.850	4.865	5.700
June	5.000	5.850	4.850	5.700
July	5.000	5.850	4.850	5.700
August	4.854	5.850	4.704	5.700
September	4.929	5.850	4.779	5.700
October	5.308	5.850	5.158	5.700
November	5.726	5.850	5.578	5.700
December	5.500	5.850	5.350	5.700
Year	5.179	5.793	5.029	5.643

New York and St. Louis quotations, cents per pound

TIN

	Straits New York		Standard, Spot London	
	1940	1941	1940	1941
January	46.707	50.154	240.716	256.648
February	45.851	51.293	242.833	264.975
March	47.079	52.067	251.711	270.131
April	46.815	51.981	252.080	269.775
May	51.570	52.166	264.098	267.534
June	54.618	52.685	273.438	262.750
July	51.591	53.481	265.592	258.272
August	51.176	52.385	262.455	257.013
September	50.348	52.000	251.024	256.364
October	51.490	52.000	257.946	255.842
November	50.577	52.000	258.214	256.713
December	50.101	52.000	256.988	(a) 257.625
Year	49.827	52.018	256.425	261.137

New York quotations, cents per pound. London, pounds sterling per long ton. Average of 6 days. Quotations suspended Dec. 9.

ZINC

	St. Louis		
	1939	1940	1941
January	4.500	5.644	7.250
February	4.500	5.534	7.250
March	4.500	5.750	7.250
April	4.500	5.750	7.250
May	4.500	5.803	7.250
June	4.500	6.235	7.250
July	4.516	6.250	7.250
August	4.719	6.389	7.250
September	6.104	6.920	7.250
October	6.500	7.250	7.942
November	6.500	7.250	8.250
December	5.980	7.250	8.250
Year	5.110	6.335	7.474

St. Louis quotations, Prime Western, cents per pound.

CADMIUM AND ALUMINUM

	Cadmium		Aluminum	
	1940 (a)	1941 (a)	1940	1941
January	79.038	80.000	20.000	17.000
February	80.000	82.273	20.000	17.000
March	80.000	89.038	19.769	17.000
April	80.000	90.000	19.000	17.000
May	80.000	90.000	19.000	17.000
June	80.000	90.000	19.000	17.000
July	80.000	90.000	19.000	17.000
August	80.000	90.000	18.000	17.000
September	80.000	90.000	18.000	17.000
October	80.000	90.000	18.000	15.000
November	80.000	90.000	17.522	15.000
December	80.000	90.000	17.000	15.000
Year	79.920	88.443	18.691	16.500

Aluminum in cents per pound, 99 plus per cent grade. Cadmium, cents per pound. (a) Producers' price, commercial sticks.

ANTIMONY, QUICKSILVER, AND PLATINUM

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) New York	
	1940	1941	1940	1941	1940	1941
January	14.000	14.000	156.962	165.846	40.000	36.000
February	14.000	14.000	178.000	170.182	40.000	36.000
March	14.000	14.000	180.921	177.692	40.000	36.000
April	14.000	14.000	173.538	180.077	38.923	36.000
May	14.000	14.000	181.538	180.000	38.000	36.000
June	14.000	14.000	197.360	183.920	38.000	36.000
July	14.000	14.000	194.423	188.577	38.000	36.000
August	14.000	14.000	184.111	192.000	38.000	36.000
September	14.000	14.000	173.333	192.440	36.167	36.000
October	14.000	14.000	168.846	193.615	36.000	36.000
November	14.000	14.000	168.391	196.273	36.000	36.000
December	14.000	14.000	164.960	199.654	36.000	36.000
Year	14.000	14.000	176.865	185.023	37.924	36.000

(a) Antimony, cents per pound, ordinary brands, in cases; in bulk f.o.b. Laredo, Tex., 13.000 for December. (b) Quicksilver, dollars per flask of 76 lb. (c) Platinum, per ounce troy.

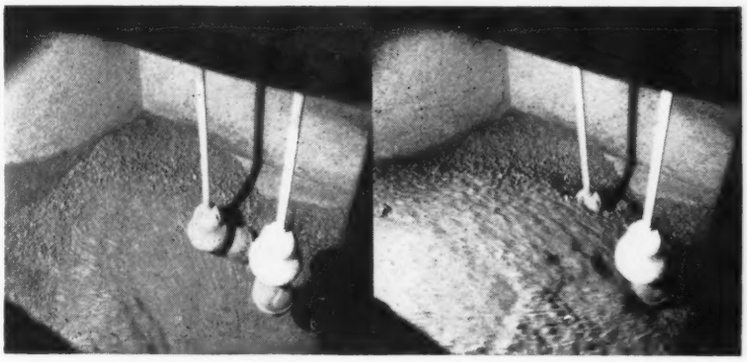
PIG IRON

	Bessemer		Basic		No. 2 Foundry	
	1940	1941	1940	1941	1940	1941
January	23.50	24.50	22.50	23.50	23.00	24.00
February	23.50	24.50	22.50	23.50	23.00	24.00
March	23.50	24.50	22.50	23.50	23.00	24.00
April	23.50	24.50	22.50	23.50	23.00	24.00
May	23.50	24.50	22.50	23.50	23.00	24.00
June	23.50	24.50	22.50	23.50	23.00	24.00
July	23.50	24.50	22.50	23.50	23.00	24.00
August	23.50	24.50	22.50	23.50	23.00	24.00
September	23.50	24.50	22.50	23.50	23.00	24.00
October	23.50	24.50	22.50	23.50	23.00	24.00
November	23.50	24.50	22.50	23.50	23.00	24.00
December	23.50	24.50	22.50	23.50	23.00	24.00
Year	23.50	24.50	22.50	23.50	23.00	24.00

Iron, dollars per long ton. F.o.b. Mahoning and Chenango Valley furnaces

USEFUL OPERATING IDEAS

Mercury Deflection Switches Maintain Constant Feed



Left: Flow of ore out of bin is about to allow ball of one Tellevel to return to plumb, thus starting conveyor-elevator which will refill bin. Right: Surge bin has filled until material has pushed nearest ball out of plumb. A little more and self-contained mercury switch will shut off feed

DEFLECTION SWITCHES of the mercury type installed as a coordinating pair in the crushed-ore surge bin feeding the flotation plant of the Mahoning Mining Co., Rosiclare, Ill., improved the constancy of feed to the grinding circuit by providing closer control of the head with which the ore gravitates to a Hardinge constant-weight feeder. The material is fluorspar-zinc-lead ore, crushed to $\frac{3}{8}$-in.

For this control two Tellevels purchased from the Stephens-Adamson Mfg. Co. were installed inside. One functions to start a 7-in. Redler conveyor-elevator when the bin "level" drops to a predetermined slope and the other to stop that conveyor when the bin has filled to a "level" some 2 ft. higher.

As will be noted from the photograph, made with the camera pointing down at a manhole in the top of the bin, the Tellevels are installed on the ends of rigid conduit and operate by deflection of the balls riding on the slopes of the incoming and outgoing material. The mercury contacts in the Tellevels operate a magnetic switch controlling the conveyor-elevator motor.

▼ ▼ ▼

Lubricating the Hoist Ropes

MINE HOIST ROPES do not always receive the care and attention they deserve. All too often the high-grade steel is left unprotected from the corrosive and deteriorating effects of acid water and tainted mine air, thereby materially shortening its useful life, in the opinion of Paul C. Ziemke, 2032 West Keefe Ave., Milwaukee, Wis.

Wire ropes should be oiled at regular intervals during normal use and while idle for any appreciable length of time. To accomplish this no high-priced equipment is needed, as the job is easily done with apparatus constructed in any ordinary shop.

Illustrated here are two popular types of oiling boxes, the long model being used for horizontal rope runs and the short one adapted to oiling vertical ropes. As rope dimensions vary greatly, the boxes will vary accordingly, and therefore dimension data are intentionally omitted.

While oil distributors sell specially prepared rope lubricants, good results can be obtained with ordinary drain oil, salvaged from the numerous jobs performed by maintenance staffs. Such oil should, of course, be permitted to stand for a time to settle out any particles which would prove injurious to the rope.

To conserve oil and to avoid much splashing and spattering, the outlets in either type of box must be stoppered with rags loosely wrapped about the rope at the point of exit.

Of course, no hard-and-fast rule as to the frequency of oiling necessary for any given job can be laid down here. Such factors as the rate of travel, the load carried, and the number of bends, as well as the severity of exposure to corrosive fumes or water, must determine the number of oilings required per month.

A close inspection will usually reveal whether or not the oil is getting down into the valleys and creases as it should to keep the rope properly lubricated. If the rope remains pliable, one may safely assume that the oil is penetrating the twists and strands down into the core of the rope and is maintaining an oil film between the strands as they rub over each other.

While over-oiling, especially where drain oil is used, may not be expensive, it does take men's time and may add to the unsightliness of sheaves, idler stands, and hoist-house floors. Thus periodic inspections made to detect broken strands and wear will also reveal the state of lubrication.

Above all, one must avoid perfunctory application, especially in cold weather, when penetration is best achieved by heating the oil prior to pouring it in the box.

Merely forming a fine-looking coating on the surface, for the first few sheaves or idlers to scrape off, is only a waste of time.

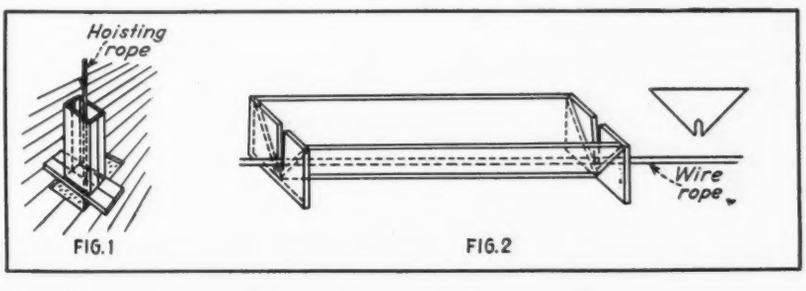


FIG. 1 FIG. 2

▼

Building Up Worn Jaw Plates

AN ILLUSTRATION of how scrap material can be put to use follows: In building up worn jaw-crusher plates, our previous practice had been first to weld nickel-manganese filler or applicator bars to the worn plates, and then fill in and even up with hard-facing material,

writes N. K. Karchmer from Farmville, Va. When a recent effort to replenish the stock of filler bars failed, due to lack of priority preference rating, the difficulty was met by making use of worn discarded manganese-steel rod-mill liners. One of these was cut into small squares with an oxyacetylene torch. Liners of various thicknesses could be selected from the old material. The squares were welded to the worn jaw plates with mild-steel electrodes, and the space between the squares filled in with hard-facing electrode.

This method of repair proved satisfactory, quicker and more economical than the one that had been used previously in the plant.

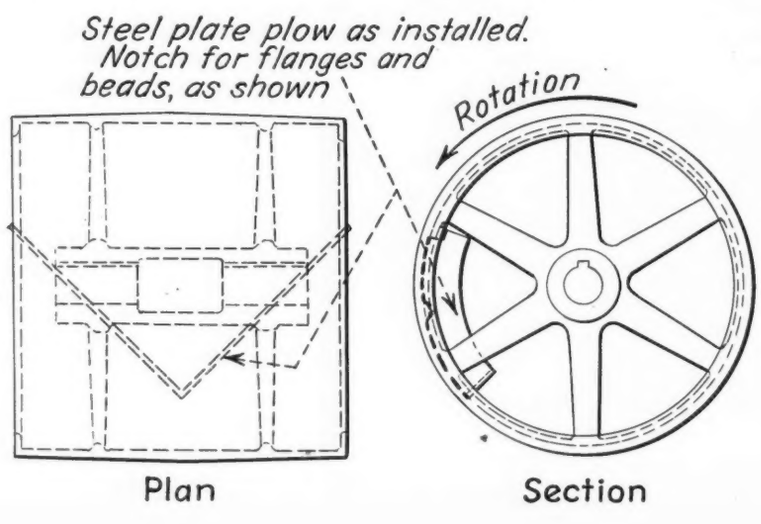
▼

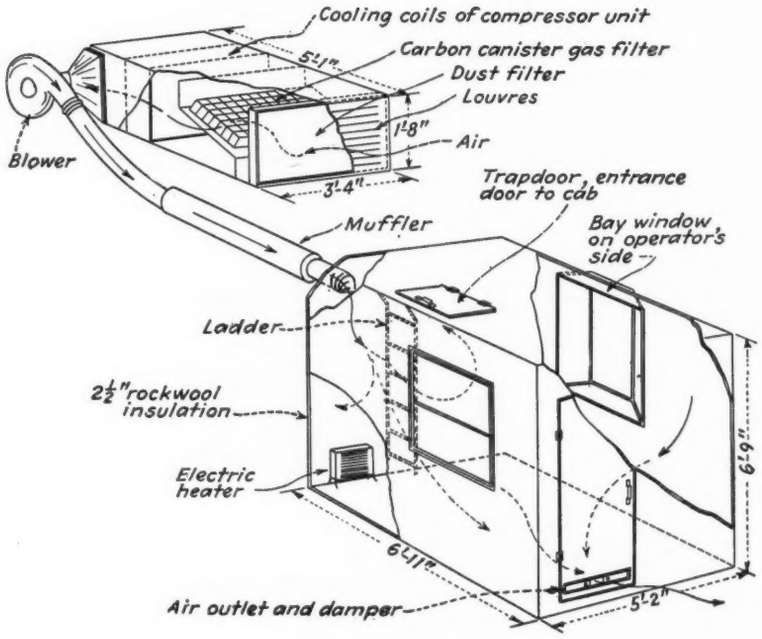
Debris Plow for Head Pulley

AT THE Chile Exploration Co., Chuquicamata, Chile, writes Elwood Stockman, head pulleys on belt conveyors handling ore up to 3 in. in size have the double-flanged rim and double-beaded construction shown in the accompanying sketch.

Some of the material discharged from the conveyors occasionally bounces around inside the discharge chute and lands inside the head pulley. Unless cleaned out by hand, this "dead-head" ore rides around inside the pulley indefinitely and the friction wears the inside surface of the pulley away needlessly.

The operating department devised the plow illustrated, which is continuous-welded inside the pulley, and whose functioning is automatic as the pulley rotates. Care must be taken in mounting the plow that its nose heads into the direction of rotation of the pulley; also that the discharge hopper extends far enough back of the center line of the pulley so that it will catch the débris thrown out of the pulley by the plow.





Air-Conditioned Crane Cab

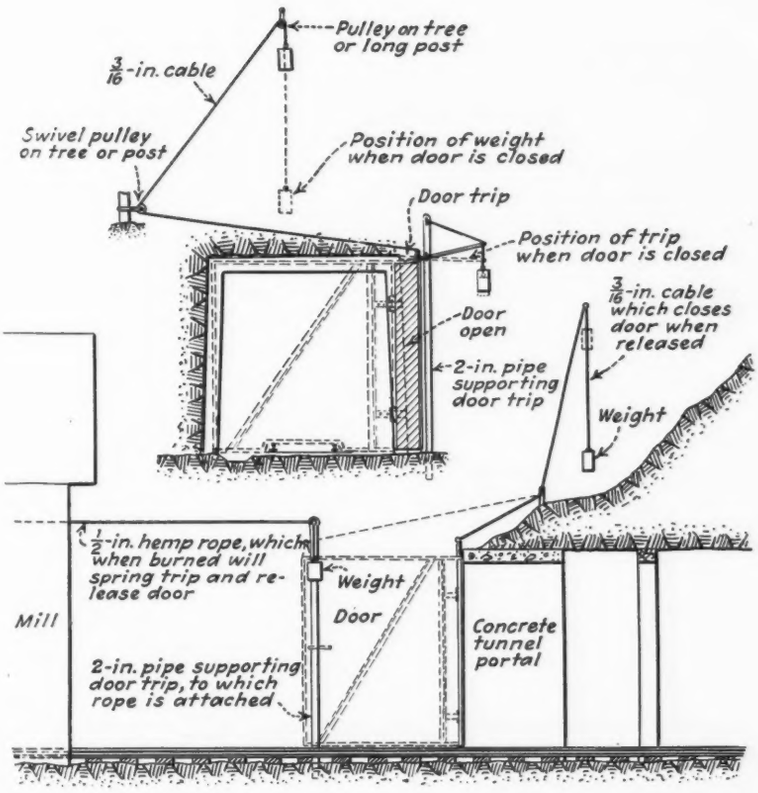
AN INNOVATION at the Garfield smelter of American Smelting & Refining Co., Garfield, Utah, is the development of air-conditioned crane cabs in the converter building to protect the crane operators from smoke and fumes, and thus dispense with the use of gas masks or respirators. Design and layout are shown in the accompanying drawing. When in use about 450 c.f.m. of air is drawn through filters, passed through activated carbon odor absorbers to remove SO_2, cooled by mechanical refrigeration, and finally circulated through the cab, a complete change of air being made every two minutes. Pressure inside the cab is 0.07 in. of water above atmospheric, which keeps smoke from leaking in. Temperature is kept at 10 to 15 deg. F. below that outside the cab in summer. During the winter an electric heater keeps the air at the desired temperature. The absorbers last about 90 days, after which they must be reactivated by washing in live steam.

Equipment comprising the air-conditioning system includes two 20x20x2-in. air filters; two units of odor absorbers, 20 canisters per unit, filled with activated carbon; a compressor driven by a 2-hp. motor; a cooling coil; an expansion valve; thermostat; blower; and a wall-mounted 2,000-watt electric heater. The cab proper is insulated with 2½ in. of rock wool. All windows are of safety glass, and so hinged as to provide easy access for cleaning inside and out.

▼

Self-closing Fire Door

REALIZING the danger of a surface plant fire spreading to the nearby underground workings and thus impeding or stopping mine production entirely, W. J. McMillan, superintendent, Glacier mine, Seneca, Plumas County, Calif., developed the self-closing fire door illustrated in the self-explanatory sketch and installed it at the main adit. The mill is but a short distance away. Installation of the door involved making a concrete tunnel portal, and providing the fire door proper and a simple operating mechanism actuated by steel and hemp ropes and counterweights. The latter consists of a counterweighted door-trip on a column made from 2-in. pipe, with a ½-in. hemp rope leading to the mill building holding it in a locked position (door is open), and a 3/16-in. cable and counterweight set up as shown. If a fire starts in the mill or near


Pulley on tree or long post
3/16-in. cable
Swivel pulley on tree or post
Position of weight when door is closed
Door trip
Position of trip when door is closed
3/16-in. cable which closes door when released
Door open
2-in. pipe supporting door trip
Weight
1/2-in. hemp rope, which when burned will spring trip and release door
Weight
Door
Mill
Concrete tunnel portal
2-in. pipe supporting door trip, to which rope is attached

the tunnel portal, the hemp rope burns and as a consequence springs the trip, thus releasing the door, which is closed immediately by the counterweight at the end of the 3/16-in. steel cable. As designed, the door is easy to install, and the cost is moderate. It is supported by two heavy hinges, and 1/16-in. sheet iron and 1¼-in. angle iron were used in its construction.

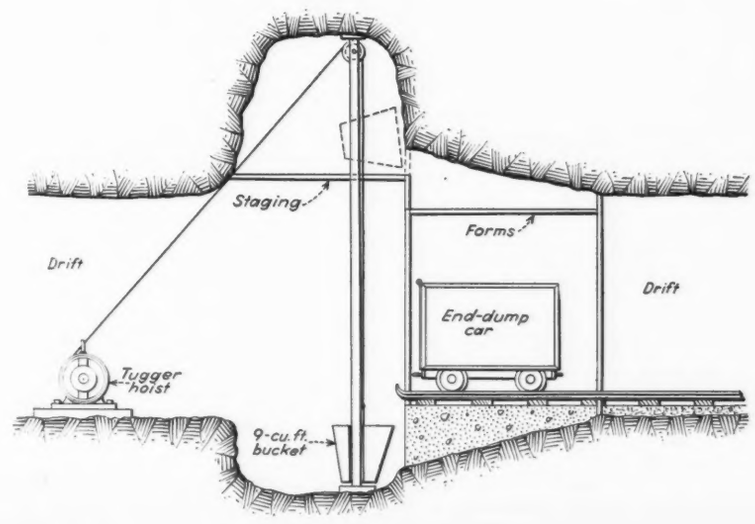
▼

Concreting Bulkhead Doors

ONE of the most tedious and exacting jobs occasionally carried out underground in wet mines is the concreting of water bulkhead doors. The work must be done rapidly so as to interfere as little as possible with hoisting and transportation. Speed and smooth and safe operations depend to a great extent on the efficiency of method and equipment layout used at the work site. The accompanying sketch shows the practical arrangement used at the Denn mine of the Shattuck Denn Mining Corporation, Lowell, Ariz., which has cut the concreting time from 50 to 30 hr.

Use is made of a simple hoisting arrangement consisting of a wooden hoisting frame installed between the two pockets shot out previously at the top and bottom of the drift, a 9-cu. ft. dump bucket, and a small tugger hoist. The concrete mixture is brought to the site in small end-dump cars discharging directly into the bucket at the bottom of the hoisting frame. The full bucket is raised by the tugger hoist and dumped by the operator standing on the wooden platform or staging into the upper section of the bulkhead door.

At the Denn mine, installation of water bulkhead doors is usually done during week ends, and, since adoption of the method described, the work always has been completed before Monday morning. J. A. Wilcox, superintendent, kindly supplied the information given.



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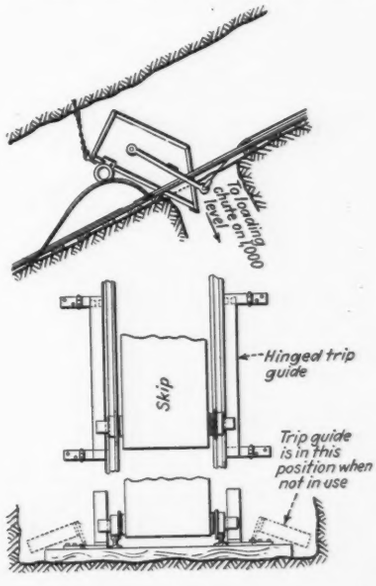
A Practical Dump

RECENTLY we faced the problem of transferring waste from the 1,200 level to the 1,000 level for backfilling in the Stank mine, writes W. G. Emminger, general superintendent, Nevada-Massachusetts Co., Mill City, Nev. The mine is opened by an incline shaft, and it was thought that the only way to do the work was to dump the waste at the 1,000 level station and then shovel it into cars for transfer to places to be filled. Because of the labor and time required this was rather costly. To do the work mechanically called for development and installation in the shaft of an automatic dumping arrangement. This was done with the simple layout shown in the sketch. It involved driving a short raise from the 1,000 level to the shaft, followed by installing a loading chute and trip mechanism in the shaft. The skip proper was fitted with wheels with extension flanges to engage the two trip guides alongside the shaft rails. These are made from ½x4-in. steel, and welded to hinges bolted to the rail sleepers. Operation is simple. The loaded skip is hoisted slowly, and as it approaches the guides the extension

Hinged guides serve for dumping skip



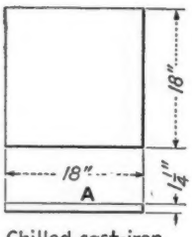
flanges of the wheels engage them, lift the end of the skip off the rails and thus dump it after the operator has secured the chain suspended from the shaft roof to the end of the skip. When the skip is empty, the chain is removed and the skip lowered to the 1,200 level for loading. When not in use, the trip guides are thrown back as indicated.

▼

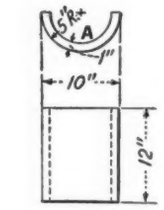
Chute Liners That Last

AT A MESABI WASHING PLANT the crude ore was fed to a 36-in. belt conveyor through a 32-in.-diameter chute at 800 tons per hour. Material size varied from 4-in. to 100 mesh. The chute was 25 ft. long and sloped at 45 deg. The ore was so abrasive that it wore out on the bottom in one week when the chute was lined with ½-in. mild-steel plate. Next, 1¼-in. square bars were tried, but these lasted only three weeks and were hard to replace.

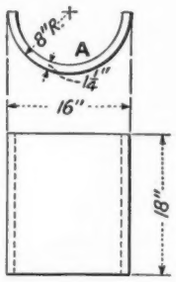
Solution was found in the use of a three-section chilled cast-iron liner, shown in the drawing. With it the center section showed less than ¼ in. wear after 1,000,000 tons of crude ore had passed over it. The second year the center section was moved to the right and the right-side section was placed in the bottom. This lasted for 1,000,000 tons. The third year the left-hand section went to the bottom and the old one replaced it. This lasted likewise for 1,000,000 tons. Today, nothing but chilled cast-iron liners are used in the chutes. The three diameters shown are the only sizes used in the plant. The chill should extend clear through the castings starting on the side A indicated in the cut below.



Chilled cast-iron plate liner

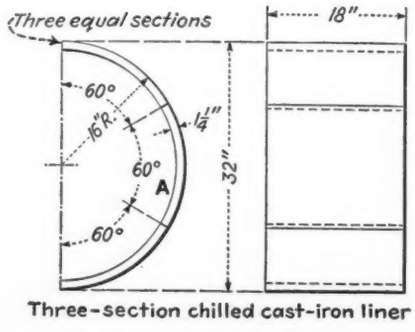


Chilled cast-iron liner for 10-in. pipe



Chilled cast-iron liner for 16-in pipe

The three-section chilled cast-iron liner used in chute in Mesabi washing plant is shown at the lower left

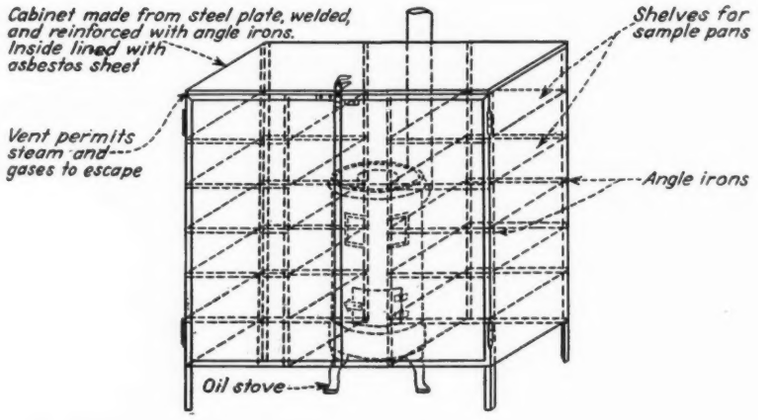


Three-section chilled cast-iron liner

A Sample Dryer

STANDARD CYANIDING CO., near Lovelock, Nev., is mining a large daily tonnage of low-grade gold ore by open-pit methods. A corresponding number of samples are taken and assayed every day. As most of the material contains moisture, an efficient dryer was necessary.

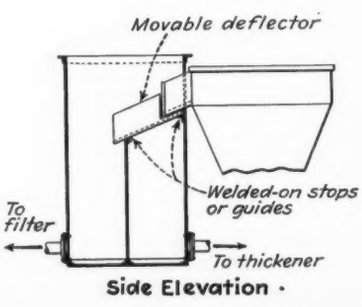
The unit evolved after careful study (shown in the sketch) has given satisfaction. It is simple and compact, all-welded, easily moved, and uses a small, conventional oil stove as heating element. The cabinet frame is of angle irons, with thin, steel sheets for covering. Interior lining consists of asbestos sheets. The pans rest on movable shelves on angle-iron guides. Steam and fumes can escape through vents immediately below the top of the cabinet. D. Ross Fraser, secretary-treasurer of the company, kindly made this information available.


Cabinet made from steel plate, welded, and reinforced with angle irons.
Inside lined with asbestos sheet
Vent permits steam and gases to escape
Shelves for sample pans
Angle irons
Oil stove

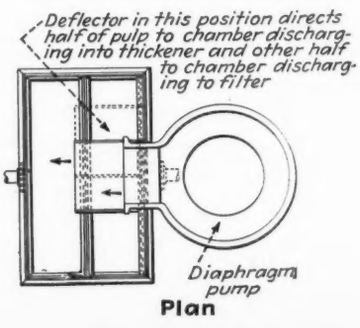
Controls Pump Output

THE movable deflector shown at the bottom of the page has simplified operation of diaphragm pumps at the plant of Golconda Syndicate, at Golconda, Nev., S. Power Warren, superintendent. Prior to its installation thickener load was controlled by altering the pump stroke, increasing or decreasing the pump output. Where pumps of older design are used this means a brief shutdown to make necessary adjustments. With units on which the stroke can be adjusted while running some time will elapse until the desired pump flow is attained. By using the deflector, this loss of time can be avoided. The pump flow can be directed within a split second either direct to the filter or back to the thickener, or so split that a quarter or a half flows to the filter and the rest returns to the thickener, by simply pushing the deflector to the desired position. The complete device consists of a steel tank partitioned in the center, and a movable deflector, made from steel plate, operating below the discharge lip of the pump. Two stops, one welded onto the lower end of the deflector and the other on the side of the tank as shown, guide the sideward movement of the deflector. Material discharged into the chamber nearest to the pump flows back to the thickener, and that in the second chamber goes to the filter.

Steel tank equipped with movable deflector for directing discharge from diaphragm pump to filter or to thickener



Side Elevation


Deflector in this position directs half of pulp to chamber discharging into thickener and other half to chamber discharging to filter
Diaphragm pump
Plan

PERSONAL ITEMS

Wing L. Lew, of Oakland, Calif., has gone to Mina El Oro, Chilecito, La Rioja, Argentina.

Frank Godden, general manager of Bulolo Gold Dredging Ltd., Wau, New Guinea, is visiting Australia on leave.

John S. Anderson, of Kellogg, Idaho, has gone to South America in the employ of Chile Exploration Co., Chuquicamata, Chile.

Val De Camp, manager of the tin properties of Mauricio Hochschild in Bolivia, recently returned to the United States on vacation.

Gordon H. Chambers, vice president of the Foote Mineral Co., recently returned from a three weeks' trip to South America.

Burr Wheeler, vice president of Chile Exploration Co. and Andes Copper, both subsidiaries of Anaconda, is visiting the company's mining properties in Chile.

B. M. Snyder, a consulting mining engineer of Los Angeles, has been elected vice president of the Mining Association of the Southwest, to fill a vacancy.

H. Sargent, of the British Columbia Department of Mines, is studying at the Massachusetts Institute of Technology for his doctor's degree.

John G. Kura has been named to the technical staff of Battelle Memorial Institute, Columbus, Ohio, where he has been assigned to metallurgical research.

E. S. Ling, who was recently with Mount Morgan, Ltd., has joined the engineering staff of Zinc Corporation Ltd., Broken Hill, New South Wales.

Charles L. Bradbury, of Albuquerque, N. M., vice president in charge of mine operation for the Raskob interests, recently visited New York City on business.

Elgin Bryce Holt, formerly field engineer for the Arizona State Department of Mineral Resources, with headquarters at Kingman, Ariz., has returned to Phoenix.

George A. Ball, formerly a Yukon dredgemaster and more recently in charge of a large dredge for Pato Consolidated Dredging, Ltd., in Colombia, South America, is visiting in Vancouver.

Roger W. Straus, recently elected to the post of president of A.S.&R., was also appointed chairman of the executive committee, and not the finance committee, as erroneously announced in the December issue of *E.&M.J.*

Fred C. Jones, who for 14 years was superintendent of the Portland mine, at Cripple Creek, has been made superintendent of the Ben Butler Mining Co. at Redcliff, Colo.

Ernest Oberbillig has gone to Bolivia, where, with headquarters at La Paz, he will serve as metallurgist with the Foreign Minerals Division of the U. S. Bureau of Mines. He sailed from New York on Dec. 5 on the "S.S. Santa Clara," for Mollendo, Peru. Mr. Oberbillig, with **E. P. Frink,** was co-author of the article "Recovering Slime Cassiterite by Soap Flotation," which appeared in the December, 1941, issue of *E.&M.J.* and which dealt with research work in Argentina for Soc. Min. Pirquitas, Picchetti y Cia.

ERNEST OBERBILLIG

E. L. Reed has been added to the staff of the Foote Mineral Co. as project engineer to do research and development work on milling and concentration problems.

J. J. Inman has been appointed district manager for all operations in southwest Missouri, Arkansas, Oklahoma and Kansas of the American Zinc, Lead & Smelting Co. Mr. Inman has been with American Zinc since 1915.

Graham Nelson, formerly assistant geologist for Antamok Goldfields Mining Co., Baguio, P. I., has been transferred to Masbate Consolidated Mining Co., Masbate, P. I., where he is junior engineer and geologist.

Charles Von Oden Hughes, Jr., is no longer in the employ of St. Joseph Lead Co. at Bonne Terre, Mo., but is now with the Oromite Company, of Los Angeles, Calif., in its plant in Terrebonne, Oregon.

Robert M. MacIntosh has been appointed head of the division of analytical chemistry at Battelle Memorial Institute, Columbus, Ohio. Previous to joining the Battelle staff Mr. MacIntosh had been associated for 15 years with Guggenheim Bros. Research Laboratories, of New York City.

B. A. Gould, manager of several quicksilver mines operated by H. W. Gould & Co. in California and Nevada, has left his office in the Mills Building, San Francisco, for a professional trip to South America.

Scott Turner, mining engineer, of New York, represents the A.I.M.E. on the Advisory Board on Sanitary and Public Health Engineering of the Medical Division of the Office of Civilian Defense. The board represents the major engineering and related societies.

George E. Lynch, consulting engineer for Phelps Dodge on dust and fume problems in the company's Morenci plant, now nearing completion, is undertaking similar work for Basic Magnesium, Inc., at its $63,000,000 project in Nevada.

M. M. O'Brien, who has been serving as a "dollar-a-year" man with the Munitions Department at Ottawa, has completed his work and resumed his duties in the mining department of Consolidated Mining & Smelting Company of Canada, Ltd., at Trail.

John J. Inman, of Joplin, has been appointed district manager of the American Zinc, Lead & Smelting Co., according to an announcement by **Howard I. Young,** of St. Louis, company president. Inman, who has been with the company since 1915, succeeds the late G. W. Johnson, of Joplin.

Harold E. Wright, formerly with the Galigher Co. Booth-Thompson Division, Salt Lake City, Utah, as field metallurgist, left recently to join the Anaconda Copper Mining Co., Anaconda, Mont., as an assistant superintendent of concentration in charge of the zinc concentrator.

Stanley E. Johnson, recently with Patiño tin mines, Llallagua, Bolivia, was reported last month to have left the United States for the property of the Suyoc Consolidated Mining Co., in the Philippines. The status of that company's operations since the opening of hostilities in the Philippines has not so far been revealed.

Arthur F. Johnson, formerly of Silverton, Colo., has joined the staff of the Reynolds Metals Co. at Listerhill, Ala. Mr. Johnson will be connected with the smelting division of the aluminum plant of the Reynolds company. He was formerly in charge of the development program of the Silver Lake mine, in Silverton, coming there from Western Australia, where he was employed by the American Smelting & Refining Co.

Everette Lee DeGolyer, consulting petroleum engineer of Dallas, Texas, and Deputy for Conservation under the Federal Petroleum Coordinator for National Defense, has been awarded the John Fritz Medal for 1942. Sponsored by the four Founder American Engineering Societies, the medal is generally recognized as the greatest distinction in the gift of the engineering profession.

Herbert Anscomb, Conservative member of the British Columbia Legislature, has been appointed Minister of Mines and Trade and Industry in the new coali-

tion government of **Premier John Hart.** He succeeds the **Hon. C. S. Leary,** who held the portfolio briefly following the transfer of **Hon. W. J. Asselstine,** former minister, to the Department of Labor.

Frank E. Woodside, manager of the British Columbia Chamber of Mines, reviewed mining activity in this province before the annual convention of the Northwest Mining Association in Spokane. He later addressed the West Coast Mineral Association in Seattle on "The Need for and Conduct of a Prospecting School."

T. C. DeSollar, of the Woodward Iron Co., at Bessemer, Ala., chairman of the Southeast section of the A.I.M.E., presided at a joint meeting on Dec. 19 of

T. C. DE SOLLAR

the Southeast Section of the Institute, the women's auxiliary, and the Birmingham Engineers Club. The meeting was held in Birmingham, Ala.

J. A. H. Paterson on Jan. 1 joined the staff of the Canadian Federal Metals Controller. Until the date mentioned Mr. Paterson was assistant general manager of the Mining Corporation of Canada. He is an expert in the mining and marketing of lead, zinc, and copper.

Alan Broderick, former student of mining and geology at Michigan College of Mining and Technology, and University of Minnesota, upon completing an assignment in New York State for the M. A. Hanna Co., joined the geological staff of the Cerro de Pasco Copper Corp. at Morococha, Peru.

Richard John Heinrich, chief engineer for La India mines of Nicaragua, has been transferred to the El Limon mine, owned by same company, as mine superintendent. La India and El Limon mines are owned by Noranda, of Canada. Mr. Heinrich was formerly in the Philippines for Marsman & Co. La India and El Limon are rapidly becoming the largest gold producers in Central America.

Harry A. Rapelye, of Kansas City, Mo., has been appointed head of the Nickel Branch of the Office of Production Management. Mr. Rapelye replaces **Louis Jordan,** who has been acting chief. Mr. Jordan will continue with OPM on a part-time basis, devoting the rest of his time to the Research Council of the National Academy of Science.

John Worcester has recently been added to the staff of the Foote Mineral Co. in a temporary capacity to direct the remodeling operations of the new Foote grinding and milling plant at Exton, Pa. Graduated from the Massachusetts Institute of Technology in 1930 as a mining engineer, Mr. Worcester has since been engaged in mining operations in Quebec, Alaska, Utah, and Bolivia.

D. F. Hewett, representing the U. S. Geological Survey; **E. W. Pehrson,** representing the U. S. Bureau of Mines; and **Charles Will Wright,** representing the Coordinator of Inter-American Affairs of the Office of Emergency Management, comprise the official delegation from the United States to the First Pan American Congress of Mining Engineering and Geology, convening in Santiago, Chile, on Jan. 15. The party left the United States Jan. 7, expecting to stop en route at Lima and La Paz. On the return trip the members of the delegation will go to Buenos Aires and Rio de Janeiro. The purpose of their visit will be to confer with officials in mining departments of South American countries to stimulate production of minerals needed in the war.

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OBITUARY

O. M. Kuchs, general manager of Andes Copper and well known throughout South America, died recently.

Gilbert Hambledon Tompkins, secretary of Sauerman Bros., Inc., Chicago, Ill., died on Dec. 2, 1941. He was born at Butler, New York, Sept. 29, 1884.

Emil E. Dieffenbach, metallurgist and formerly general manager of the Balbach Smelting & Refining Co., died in Newark, N. J., on Dec. 4 at the age of 79.

Halleck W. Seaman, a former president of the American Mining Congress, died on Dec. 15 at Clinton, Iowa. He was 81.

Hugh Dillon, who had been connected with Mexican mining in various executive capacities for several years, died, aged 68, in the British Hospital, Mexico City, Nov. 27. Mr. Dillon was a native of Glasgow, Scotland.

Captain Frank E. Keese, Sr., of Ishpeming, Mich., general superintendent for Oliver Iron Mining Co. on the Marquette range until his retirement in 1932 after 40 years of service, died on Dec. 6 at the age of 75.

Dalton B. Pittman, superintendent of the Santa Ana mine of the Cia. Minera Real del Monte y Pachuca, S. A., was electrocuted when a loose high-tension electric cable fell on him on level 580 of the mine Dec. 9 last. Mr. Pittman, an American, had worked in Mexico for many years.

Franklin Thompson Sutherland, mining engineer, age 87, died on Nov. 18, 1941. In 1876 Mr. Sutherland went west to the Sioux Indian reservation in the Black Hills and became the first recorder in that territory. Later he pursued his profession in Colorado, Nevada, and Arizona.

Frederick Anthony Lovell, distinguished geologist and mining engineer, who fought in both the Civil War and the Indian wars, and who was for many years geologist for the Lord Duffern Syndicate, of England, died on Dec. 13 at his home in Little Tugunga Canyon, California, at the age of 102.

Alonzo F. Bardwell, 79, Salt Lake City assayer, died at his home on Nov. 27, 1941. Mr. Bardwell came to Salt Lake City to operate an assaying office in 1908 and had been active ever since. Born in Brooklyn, New York, June 24, 1862, he graduated in 1883 from Columbia University with the degree of engineer of mines. In 1885, he entered the assaying business at Aspen, Colo.

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LETTERS

Prices Necessary to Bring Out Maximum Production of Chromite in United States

The Editor:

SINCE the organization of the Advisory Committee of the Council of National Defense in 1940, officials of that committee and others familiar with the situation have been unanimous in the opinion that domestic sources of chromite should be investigated, developed, and put into production. The only practical step in that direction for over a year, however, was a series of investigations by the U. S. Bureau of Mines and the Geological Survey. In the fall of 1941 arrangements were made to initiate development of low-grade deposits in Montana. These may be brought into production in 1942. They are situated in high mountainous regions, with low temperatures and deep winter snows lasting into June, with resultant difficult operating conditions.

The U. S. Bureau of Mines has a record of 949 chrome mines and prospects in California and Oregon, most of which are in areas that will permit all-year operation. Official estimates are that these will yield 100,000 to 150,000 tons a year if prices are at figures prevailing in 1918.

History of Domestic Production 1914-18

Prior to 1914 domestic production amounted to not more than a few hundred tons per year, all of which was used locally on the Pacific Coast.

1915: Shortly after the declaration of war in 1914 consumers formerly depending on foreign supplies began to search for chrome ores on the Pacific Coast. The initial prices offered were 40c. to

50c. per *short ton* unit f.o.b. cars at nearest loading point. This price prevailed for most of 1915 and brought out 3,674 *short tons.*

1916: Prices were increased to 80c. to $1 per *short ton* unit, and this resulted in shipment of 52,679 *short tons.*

1917: During much of this year prices remained at about $1 per *short ton* unit (40 percent basis). Mines situated near railroad were being exhausted, and production fell to 48,972 *short tons.*

1918: In the fall of 1917 prices were raised on a graduated scale so that 48 percent ore was sold at $1.50 per unit. The price of 35 percent ore was $1.10 per unit. The average price for all ore shipped was $50.38 per *short ton* and the average grade was 41 percent, equal to $1.22 per *short ton* unit.

Output of domestic mines increased to 92,321 *short tons.*

The effect of price on production is summarized in the following table:

Year	Short Ton Unit Price	Short Ton Production
1915	$ .40–$ .50	3,674
1916	.80– 1.00	52,679
1917	1.00– 1.25	48,972
1918	1.10– 1.50	92,321
1940	(*a*)0.30	2,981
1941	(*a*)0.50	(*a*)5,000

(*a*) estimated.

Current Prices

On Nov. 14, 1941, Metals Reserve Co. announced a schedule of prices at which it was proposed to contract for chrome ores. These were figures far below those required to bring out maximum output in World War I.

On Dec. 19, 1941, a revised schedule was announced, the base prices of which are above those of Nov. 14, but are still entirely too low to bring out maximum production. The relation of these prices to those prevailing in 1918 is shown in the table below. Current prices are reduced herein to *short ton* units of 1 per cent Cr_2O_3 to correspond to those of 1918, when short tons were used as the basis of settlement in all domestic contracts.

It is reported that high-grade Turkish ores purchased by the government cost approximately $1.30 per long ton unit, equal to $1.16 per short ton unit. These and other foreign ores require convoy on at least a part of the voyage. The cost of convoy is not known, but it is a direct cost and should be added to the purchase price. Domestic ores require no convoy.

About one-third of the domestic supply recently has come from the Philippines and New Caledonia. No shipments can come from the Philippines at present, and supplies from New Caledonia are in jeopardy.

Estimates of requirements for 1942 are 800,000 to 900,000 long tons, of which 250,000 to 300,000 tons was expected from these Pacific sources.

Current prices offered by government agencies are therefore below the average of the 1916 level, and about 50 percent of the 1918 figures.

It does not appear that at a time of extreme emergency the government's best interest is being served by retesting the demonstrated effectiveness of the 1918 schedules. SAMUEL H. DOLBEAR

New York, N. Y.

Glossary of Powder Metallurgy

The Editor:

WHILE a glossary of powder metallurgy is in the making and will presently be published, it may be well to draw attention to certain expressions which are again and again repeated not only in the technical papers but also in the daily press. The writer who first gave this art the name of powder metallurgy made the mistake in one of his early papers of speaking of "powdered metal" instead of "metal powders," but has long since corrected this error. Now there appears not only the expression "powdered metals" but actually "powdered metallurgy," as if a science, "metallurgy," could be powdered.

The question of whether we should speak of "metal powders" or "powdered metals" is at least debatable, but would it not be well if a uniform application were adopted? The word powder is defined by the dictionary as any solid substance in the state of fine, loose particles, as produced by crushing, grinding, or disintegration. Hence, the expression "powdered metals" should convey to the reader the impression of powder produced by any of the above means.

However, tungsten, molybdenum, or copper—to pick three of the earlier and still quantitatively the largest metals produced—are *not* produced commercially by grinding, crushing, or disintegration. The powders of those metals and many others are the result of reduction of their salts, such as oxides, or reduction by electrolysis, or as in the case of iron powder, reduction direct from the ore. Thus the powders were not produced from the solid element by mechanical means, but were produced as powders at the same time that the element, say tungsten, molybdenum, copper, and iron, was produced from the ore or the oxide.

It seems, therefore, that the designation "metal powders" would be more desirable than "powdered metals." A committee of the American Society for Metals, preparing a glossary of powder metallurgy, has adopted the designation "metal powders" as more correct, and it would be well if other scientific societies and the trade in general would follow suit. CHARLES HARDY

New York, N. Y.

Ore Occurrence At the Iron King Mine

The Editor:

I HAVE READ with interest the article, appearing in the October issue of *Engineering and Mining Journal*, "Ore Occurrence at the Iron King Mine," by H. F. Mills, and wish to offer the following comments suggested by a study of the paper.

Based on my observations in the course of examination of various mines in that region, it suggests to me that the dikes which controlled the deposition of the ores will be found to lie northward from the north ends of the orebodies, and in the plane of the vein, and to have the same rake as the orebody.

My studies established the presence of a certain type of acid dike, in each case, these having a regional strike and dip like that of the Iron King vein, and a pronounced northerly rake. The rake of the dike was beautifully illustrated in one mine by well-defined lines of upward flowage in the dike, corresponding exactly with the rake of the dike within the plane of the vein. I also found the ore to terminate abruptly against the north end of these dikes and to have the same rake as the dike.

The thought is suggested that at the Iron King the ore lies at the other end of similar dikes and bears a similar genetic relationship.

Similarly, the zonal changes described indicate to me that they have been looking at these oreshoots from the wrong end. The coarse low-grade pyrite is probably an upper and outer fringe of the mineralization, rather than the reverse. The encounter, in depth, of changes similar to those described at the north end of the oreshoots will be, I believe, an indication of approach to a true bottom of the ore.

JOHN CARTER ANDERSON

Los Angeles, Calif.

The Editor:

SINCE the article on "Ore Occurrence at the Iron King Mine" was written, further development to the north and drilling to depth have failed to find the presence of acid dikes. I agree with Mr. Anderson that the iron is the outer fringe. However, new development on three levels of a new shoot of major size has shown that the deeply buried top resembles the north ends. The ore in the top is siliceous to the point of being glassy, and grades into the siliceous sulphides on the two levels below. This is the converse of Mr. Anderson's suggestion of iron being the upper fringe. H. F. MILLS

Iron King Mining Co.,
Humboldt, Ariz.

Metallurgical ore—Short Ton Units
Min. 45% Cr_2O_3–Cr:Fe, 2.5:1.

Metals Reserve			Relation of 12/19/41
11/14/41	12/19/41	1918	Prices to 1918
66.975¢	80.370¢	$1.50	53.5%
Low Grade "A"			
Min. 40% Cr_2O_3–Cr:Fe, 2:1			
49.11¢	62.51¢	$1.25	50.0%
Low Grade "B"			
Min. 40% Cr_2O_3–No Cr:Fe Ratio			
49.11¢	53.58¢	$1.25	42.86%

NEW BOOKS

SOME ESSENTIAL SAFETY FACTORS IN TUNNELING. *By D. Harrington and S. H. Ash. Bulletin 439, Bureau of Mines. Pp. 61. For sale by Superintendent of Documents, Washington, D. C. Price 15 cents.*

BY WAY OF INTRODUCTION the bulletin states that it has always been hard to get up-to-date information on tunneling methods and tunnel accidents. Published accounts furnish much interesting material of engineering, historical or fiscal value, but usually little or no attempt is made to discuss or analyze critically the means taken to preserve the health and life of workmen. "If the basic industrial insurance rates for tunneling can be taken as a criterion of the real hazards in the industry," the authors say, "then tunneling is a more hazardous occupation than mining, as it usually carries a higher compensation-insurance premium rate." It seems to them that the higher rate of accident occurrence is due to the element speed. The paper is based partly upon their observations and partly upon studies of tunnel driving covering all types of tunnels driven in the United States in the last 25 years. The bulletin seeks to point out the problems to be solved if the safety record is to be improved "as it could and should be."

INDUSTRIAL ACCIDENT PREVENTION—A SCIENTIFIC APPROACH. Second Edition. *By H. W. Heinrich. McGraw-Hill Book Co., New York. Pp. 448. Price $3.*

THE SECOND EDITION now follows the first by a space of ten years, which have provided further test of the methods originally proposed by Mr. Heinrich. In this period, he points out, what was once looked upon as theory is now regarded as fact and the average person has become more safety-conscious. In the new edition the treatment has been modernized.

OCCUPATIONAL DISEASES — DIAGNOSIS, MEDICOLEGAL ASPECTS AND TREATMENT. *By Rutherford T. Johnstone. W. B. Saunders Co., Philadelphia and London. Pp. 558. Price $7.50.*

DR. JOHNSTONE is director of the department of occupational diseases, Golden State Hospital, Los Angeles, Calif. The material and experience that form the background for the book, he states, have been furnished by a clinic which has devoted itself to a surgical and medical industrial service for 25 years. Annual admissions to the clinic have exceeded 11,000 patients. After three preliminary chapters (Part I) dealing with workman's compensation, Dr. Johnstone divides his subject into several parts. Diseases resulting from gases, solvents, and fumes, including, among other substances, the cyanides, carbon dioxide, sulphur dioxide, carbon monoxide, and fumes from welding, receive attention in Part II, of 15 chapters; the metals in Part III, seven chapters; the dusts in Part IV, four chapters. The remaining parts discuss backache, hernia, the dermatoses, cancer, and other affections and diseases. The book has 131 illustrations.

REFRACTORIES, THE BACKBONE OF INDUSTRY. *By John D. Ramsey. Published by North American Refractories Co., Cleveland, Ohio. Pp. 115.*

THIS BOOK is reprinted from a series of articles written by the author for the *Brick and Clay Record* and published from March to December, 1940. In Part I, covering 94 of the 115 pages, the subject is treated in ten chapters under the topics: Refractories in everyday life; historical development; recent history; processing methods; technology and specification; ethics of the industry; sales methods; the middleman; economics of the industry; and selection and care of refractories. Part II deals with the history and development of the author's company, which was formed in 1929 by a merger of six companies.

SURVEY OF MINES, 1941-42, CANADA AND NEWFOUNDLAND. *Financial Post, MacLean Publishing Company, Ltd., Montreal and Toronto, Canada. Pp. 212 plus 32 pages of maps. Price $2.00.*

IN THE 16TH ANNUAL EDITION of this mining directory the publishers have maintained the customary high standard of excellence. The volume is larger than its predecessor, reflecting the increased activity of mining throughout the Dominion. Information is supplied on thousands of mining companies, and supplementary data are given in the form of maps, dividends, ore reserves, earnings and directors.

PUBLICATIONS

RECEIVED

San Juan Geology. "Structural Control of Ore Deposition in the Red Mountain, Sneffels, and Telluride Districts of the San Juan Mountains, Colorado." By W. S. Burbank. Published by permission of U. S. Geological Survey in cooperation with the State of Colorado through the Colorado State Geological Survey Board and the Colorado Metal Mining Fund. Issued by the Colorado Scientific Society, Denver, Colo., as Vol. 14, No. 5, of its *Proceedings.* Pp. 142 to 262, including separate large-scale geologic and topographic maps and geologic cross-sections of the area. Price per copy $2.

Nevada's Common Minerals (including a preliminary list of minerals found in the State). University of Nevada Bulletin, Vol. XXXV, No. 6, pp. 10, price 50 cents. Issued by the University, Reno, Nev.

Minerals of Arizona. University of Arizona Bulletin, Vol. XII, No. 3, pp. 82, price 50 cents. Issued by the University, Tucson, Ariz.

Tungsten Resources of California. A paper included in California Journal of Mines and Geology, Vol. 37, No. 2. Division of Mines, Ferry Building, San Francisco. Pp. 101.

Florida. "Contributions to Florida Vertebrate Paleontology." Geological Bulletin 22, pp. 47, Florida Geological Survey, Tallahassee, Fla. Also Bulletin 19, "Stratigraphic and Paleontologic Studies of Wells in Florida," pp. 91.

Kansas Mines. Annual Report of Mine Inspection Division and Mine Rescue Station of Labor Department, State of Kansas, for 1940. Pp. 70.

Annotated Geological Bibliography of Virginia. By Joseph K. Roberts, professor of geology, University of Virginia. Announcement is made by the Dietz Press, Richmond, Va. that this is now being printed. Orders should be sent to Alderman Library, University of Virginia, Charlottesville, Va. Presubscription price, $4. Price after publication, $5.

Index to A. S. T. M. Standards, including tentative standards, December, 1941. Issued by American Society for Testing Materials, 260 South Broad St., Philadelphia, Pa. Pp. 196. No charge.

Tin. The Longitudinal Ridged Structure in the Tin Coating of Tinplate. By B. Chalmers and W. E. Hoare. Published by The Tin Research Institute, Battelle Memorial Institute, Columbus, Ohio.

Zinc Coatings on Steel, Possible Substitutes for. Contributions to Metallurgy of Steel—No. 4. American Iron and Steel Institute, 350 Fifth Avenue, New York. Pp. 24.

Dominion Department of Mines and Resources, Ottawa, Mines and Geology Branch, has issued the following, at stated price:

Noranda District, Quebec. Geological Survey Memoir 229. Pp. 162, plus separate geologic and topographic maps. Price 50 cents. See also following item:

Bousquet-Joannes Area, Quebec. Geological Survey Memoir 231. Pp. 110, plus separate geologic and topographic maps. Price 50 cents. This area lies immediately east of Rouyn Township, in which the Noranda district is situated (see preceding item).

Beaver Mines, Alberta. Preliminary map. Geological Survey Paper 41-12. Price 10 cents.

Hillsborough, New Brunswick, Canada. Map 647A, Albert and Westmorland Counties. Also Map 646A of the adjacent Moncton area (Both geologic and topographic).

Dominion Bureau of Statistics, Ottawa, has issued the following at the stated price:

Gypsum Industry in Canada, 1940. Pp. 14. Price 25 cents.

Quebec Bureau of Mines, Quebec, P. Q., has issued the following (no charge is mentioned):

Eustis-Mine Area, Ascot Township. Geological Report No. 8. Pp. 31, plus geologic Map No. 477 of the area.

Halliwell Mine Map-Area, Beauchastel Township, Temiscamingue County. Geological Report No. 7. Pp. 27, plus geologic map No. 492.

Brazil. The National Department of Mineral Production, Rio de Janeiro, has issued the following (the bulletins are in Portuguese):

Metallurgy of Aluminum in Brazil. By Mario de Silva Pinto. Bulletin 2 of the Laboratory of Mineral Production. Pp. 55.

Some Triassic Lamellibranchs in Brazil and in Paraguay. By F. R. Cowper Reed. Bulletin 98, Geologic and Mineralogic Service. This describes the fossil forms of the Karnian fauna of southern Brazil and eastern Paraguay. Pp. 20.

Geology of Goiaz to Cuibá. Bulletin 102, Geologic and Mineralogic Service. By Alberto I. Erichsen and Axel Löfgren. Pp. 40, plus map.

The Devonian of Parana and the Geography and its Relation with the Geology. Bulletin 109 of the Division of Geology and Mineralogy. By Paulino Franco de Carvalho. Pp. 39, plus maps and illustrations.

Classification and Nomenclature of Rock Units. Preliminary Studies, No. 21, Divisio of Geology and Mineralogy. Pp. 28.

News OF THE INDUSTRY

Government Takes Control Over Importation of Minerals

THE Government has taken control of imports of 13 minerals and may add other items to the list later, according to Donald M. Nelson, Director of Priorities of OPM. General Imports Order M-63 is the instrument through which the materials will be handled by Metals Reserve Co. or other governmental agencies. The order became effective Dec. 28. The following minerals, when imported, have passed under government control:

Antimony; cadmium; chromium; copper; graphite or plumbago; kyanite and sillimanite; lead; quicksilver or mercury; rutile; tungsten; vanadium; zinc; and zirconium.

Ores and concentrates bearing the materials are in all cases included in the import order.

All future contracts of the materials listed will be made by Metals Reserve Co. or other governmental agency. Existing channels will be used in making foreign purchases and the Government intends to work through established brokers and dealers.

The order does not disturb existing contracts or commitments, except that future shipments or goods now in transit may not be sold except to Metals Reserve Co. without written authorization of the Director of Priorities. The order provides that all persons who have made arrangements for imports of minerals affected shall report the facts immediately to the Metals Reserve Co. The Government's purchasing agency is prepared to negotiate with holders of open commitments and will take over their contracts where that is feasible.

Material purchased by Metals Reserve Co. will be subject to allocation by the Director of Priorities of OPM.

Control of imports was taken to insure, so far as possible, adequate supplies for war production. In addition, a larger flow of strategic materials from present war zones may be made possible through control, as Metals Reserve can take delivery risks that a private importer could hardly face. Under control, close work is possible with the Maritime Commission for shipping space and foreign governments can participate in the war-materials program.

Prices for Chromite

▶ The reader is referred to p. 68 for a discussion by Samuel H. Dolbear of prices necessary to stimulate the production of chromite. Much of what he says applies also to manganese ore. His main point is emphasized by a comparison of price and production during the first World War and this one. The conclusion is inescapable that higher prices by Metals Reserve Company will bring out more ore.

Government Tin Control Ordered, Effective Dec. 17

▶ The Government took charge of all supplies of tin in the United States and all tin afloat consigned to this country, effective Dec. 17. Uncertainty of future shipments from the Far East has created a situation in which an actual shortage of tin may suddenly occur, the Office of Production Management holds.

About a year's supply of tin, at normal demand levels, now is on hand in the United States. Careful conservation is expected to make this supply stretch through any possible emergency period. Normally, the United States consumes between 70,000 and 75,000 tons of primary tin a year. During the current year, consumption has increased to 100,000 tons a year.

General Preference order M-43, issued by Donald M. Nelson, director of priorities of OPM, provides:

1—All supplies of tin shall be subject to specific allocation by the Director of Priorities and the purposes for which tin is used shall also be specified.

2—No tin may be sold or delivered without specific permission of the Director of Priorities.

3—Future imports of tin may not be sold except to the Metals Reserve Co. or other governmental agency.

4—Tin now afloat may not be sold

Latest List of Strategic and Critical Materials

THE ARMY AND NAVY Munitions Board has issued its most recent list of strategic and critical materials, which is given below. Materials in parenthesis are included by implication.

STRATEGIC LIST

Material	Date Designated	Class
Antimony (and ores)	1-30-40	Metal
Chromium (and ores)	1-30-40	Metal
Manganese, ferro grade (and ores)	1-30-40	Metal
Mercury (and ores)	1-30-40	Metal
Nickel (and ores)	1-30-40	Metal
Tin (and ores)	1-30-40	Metal
Tungsten (and ores)	1-30-40	Metal
Diamonds, industrial (and bort and diamond dies) (b)	6-21-40	Mineral
Mica	1-30-40	Mineral
Quartz crystal	1-30-40	Mineral
Coconut shell char	1-30-40	Vegetable
Manila fiber	1-30-40	Vegetable fiber
Rubber (including synthetic)	1-30-40	Vegetable
Silk	1-30-40	Animal fiber
Quinine (and chinchona bark)	1-30-40	Botanical

CRITICAL LIST

Aluminum	1-30-40	Metal
Bauxite (a)	3-25-41	Metal
Copper (and ores) (a)	12-11-40	Metal
Iridium (and ore) (a)	5-28-41	Metal
Platinum (and platinum group and ores)	1-30-40	Metal
Vanadium (and ores)	1-30-40	Metal
Zinc (and ores) and zinc concentrate (a)	3-11-41	Metal
Asbestos	1-30-40	Mineral
Gasoline (aviation) (a) (100 octane)	8-27-40	Mineral
Glass, optical	1-30-40	Mineral
Graphite	1-30-40	Mineral
Jewel bearings (a)	8-28-41	Mineral
Cork	1-30-40	Vegetable
Kapok	1-30-40	Vegetable fiber
Teak (a)	9-24-41	Vegetable wood
Iodine	1-30-40	Chemical
Nitrogen compounds (including ammonia, nitric acid and Chilean nitrates) (a)	12-4-40	Chemical
Phenol	1-30-40	Chemical
Tanning materials	1-30-40	Chemical
Toluol	1-30-40	Chemical
Hides (and skins)	1-30-40	Animal
Wool	1-30-40	Animal fiber
Opium	1-30-40	Botanical

(a) Designated for purposes of procurement under Public 664 — 76th Congress.
(b) Designated for purposes of procurement under Public 117 — 76th Congress.

except by special permission of the Director of Priorities.

The order states that a distributor may sell and deliver tin imported into the United States prior to the effective date of the order to his regular customers in less than 5-ton lots, subject only to the provisions of Priorities Regulation No. 1, as amended from time to time.

Inventory provisions of Priorities Regulation No. 1 will be invoked and no deliveries of tin or tin products will be made to fabricators who have ample stocks on hand.

Allocation for Vanadium

▶ Effective Dec. 20, OPM placed vanadium under a complete allocation system. General Preference Order M-23-a, which replaces M-23, provides for monthly allocations without regard to previous preference ratings. Ninety-nine percent of the vanadium supply in this country is used in the manufacture of high-speed steel for machine tools, special castings, armor plate, and alloy iron. About one-half of our supply is produced domestically and the remainder comes from Peru.

Consumers of vanadium receiving less than 50 pounds per month need not file reports with the Division of Priorities of OPM.

Ferrochromium Grades Lowered by Producers

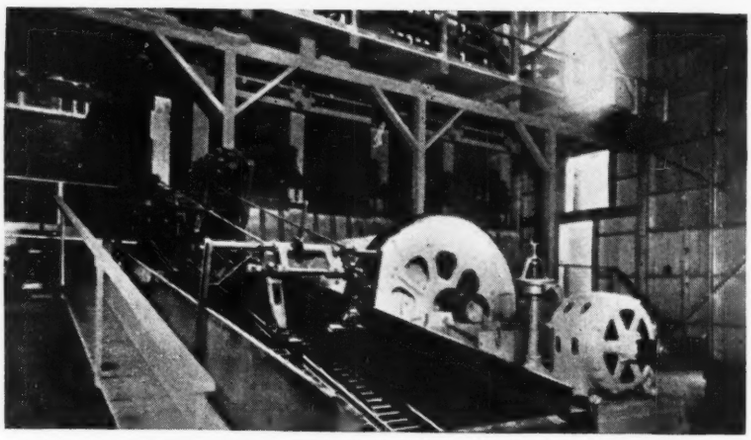
▶ Producers of ferrochromium met in Washington recently and voluntarily agreed to changes in specifications which will permit the use of lower-grade chrome ore and conservation of the higher grades, OPM announced Dec. 17. Conservation of chromium is a result of Japanese aggression in the Pacific. About 30 percent of our importations of chrome ore so far this year has come out of the Orient—Philippines, French Oceania, and India.

Present specifications of 68 to 69 percent chromium, 4 to 6 percent carbon, and 1 to 2 percent silicon will be changed to 60 to 63 percent chromium, 6 to 8 percent carbon, and 4 to 6 percent silicon, by the agreement. The agreement affects the type of ferrochromium used in making steels running up to about 3 percent chromium and does not affect stainless steel and heat-resistant alloy steels in which a larger amount of chromium is used.

The new specifications are a return to those in common use 20 years ago and are approximately the same as the ones in use during the World War.

Domestic Bauxite Resources

▶ Estimated commercial resources of bauxite will be exhausted in less than six years if foreign imports are stopped and the present rate of defense consumption is maintained. This is the conclusion of a joint report made recently by the Bureau of Mines and the Geological Survey. There are approximately 18 million tons of commercial bauxite reserves in this country, of which about half can be used without further concentration for making metallic aluminum.



Operation recently started at the mill of the Madre de Oro Gold Mines, Inc., near El Dorado, Calif. Above is a portion of the 350-ton plant that treats gold ore from the company's Church mine

CALIFORNIA

Conditions Worsening For Gold Producers

Costs are rising and labor supply is shrinking—Copper properties are receiving new attention—Outlook in quicksilver mining is for more activity

▶ Present conditions duplicate those existing in 1918 in gold mining. Costs of labor and materials are rising rapidly. Higher wages in defense operations are reducing available labor supply and creating a scarcity. Miners' attention is being strongly attracted to defense minerals. Quicksilver mining, with prices closely approaching $200 per flask, is in the forefront. Domestic quicksilver production during October was 4,000 flasks, reflecting an annual rate suggestive of early quicksilver mining days in California, when production totaled 50,250 flasks in 1875, reaching a maximum of 73,684 flasks in 1877. Price per flask was $84.15 in 1875 and $37.30 in 1877. The maximum price was $105.18 per flash in 1874. With price decline production fell off rapidly. Chrome and tungsten are also attracting attention.

▶ At Copperopolis, Calaveras County, preliminary work having for its objective the possible reopening of copper properties is reported under way. Pumps have been installed in the Keystone shaft. H. E. Bush and associates have obtained options on properties of the old Calaveras Copper Mining Co.

▶ Copper properties near Happy Camp, Siskyou County, are being looked over, according to local reports. Representatives of Newmont and Superior Copper Co. are investigating dormant properties such as the Grey Eagle and Buzzard Hill group.

▶ The La Joya quicksilver property, in Napa County, controlled by H. W. Gould and associates, has been optioned by Oakville Mercury Co., of Oakville, for $50,000 to be paid on a royalty basis. The property has been worked at various times by different companies.

▶ Rustless Mining Co., Placerville, is reported to be producing 38 percent chromite concentrate and shipping to Baltimore, Md. The company is completing a 200-ton plant and tramway in Glenn County.

▶ A. J. and G. M. Carey, owners of the Fisher Mainden claims in the Mount Oro district, near Nevada City, are planning to build a mill in 1942.

▶ At Grass Valley the Empire Star is sinking the Rowe shaft, which is now below 800 ft. It is to provide additional ventilation and hoisting capacity and is to be sunk to the 2,000-ft. level.

▶ Thirty miles west of Red Bluff, the Kleinsorge mine is reported to have 40 men employed. Additional chrome claims have been taken up. S. D. Furber and A. J. Calhoun filed on two tracts.

▶ L. A. Morrison has installed dragline placer equipment in Dutch Ravine, near Newcastle, in old drift-mining country.

▶ Near Chico, along Butte Creek, the Lancha Plana Gold Dredging Co. is build-

Protection Against Air Raids and Blackouts

THE Office of Civilian Defense, Washington, D. C., has published booklets of useful information on protection against air raids and blackouts that can be obtained on application by responsible industrial concerns. Although most of the precautions pertain to factories and other industrial plants, some of them may be applicable to mining and metallurgical works. Five pamphlets are available, as follows:

1. Blackouts. Prepared by the War Department with the aid of other Federal agencies.
2. Protective Construction—Structure Series—Bulletin 1.
3. Setting up an ARP Plan and School for Industry and Business.
4. Protection of Industrial Plants and Public Buildings.
5. A Handbook for Air Raid Wardens.

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▶CALIFORNIA

ing a dredge with 5-cu.yd. buckets. Company holdings include ground bought from Parrott Investment Co., also the W. Biswicks placers.

▶ Horse Shoe Dredging Co., dragline operators on Esperanza Creek near Railroad Flat, Calaveras County, are dismantling and removing equipment to the Jenny Lind, where they propose working another lease west of that property on the Calaveras River.

▶ Pacific Sulphur Co., of Los Angeles, has completed testing of placer ground on the Trinity River, near Weaverville, is preparing to install dragline equipment.

Mining and trucking gold ore from the open-pit Gold Standard mine of the Standard Cyaniding Co. near Lovelock, Nev., is under contract to the Isbell Construction Co., Reno, Nev.

NEVADA

Nevada Con. to Increase Copper Output

Bradshaw tailings plant completed—More equipment sought for Rip Van Winkle mill —Work of opening Ruby mill progresses —New production of quicksilver planned

▶ Further increase in copper production by Nevada Consolidated at McGill is indicated by official statements. Including direct-smelting ore from the Ruth underground mine, surface ore from the Copper Flat open pit, custom siliceous ores, and 9,000 tons of ore per day from the underground mines of Cons. Coppermines Corp., the mill and smelter are said to be handling upward of 19,000 tons daily. Numbers of Japanese at Copper Flat and McGill have been laid off and assigned separate quarters and watchmen are on duty at all vulnerable points. J. C. Kinnear is general manager.

▶ Efforts are being made to secure added equipment necessary to increase output of lead and zinc concentrate from the 100-ton selective-flotation mill of the Rip Van Winkle Cons. Mining Co. in the Merrimac district, Elko County. Among those controlling the Rip Van Winkle are several officers of Utah Copper Co. G. B. Thatcher, 206 North Virginia St., Reno, is president.

▶ Work of concreting the shaft collar and building the hoist foundations has been completed at the site of a new shaft being sunk by Eureka Corporation, Ltd., on the Ruby Hill property of the Richmond-Eureka Mining Co., two miles west of Eureka. The 8x22-ft. shaft is to be sunk 3,000 ft. to develop silver-lead-gold orebodies found by diamond drilling and north of the Ruby fault, which once marked the north limit of productive mining through the old 1,200-ft. Locan and Richmond shafts. William Sharp is manager.

▶ Operating a 120-ton Nichols-Herreshoff furnace, lately installed, the Cordero Mining Co. reports recent recovery of mercury at the rate of seven flasks per day and is providing a D retort unit to increase output to ten flasks. The property, once operated by the Bradley Mining Co., is in northern Humboldt County near McDermitt. The Cordero company is an affiliate of Horse Heaven Mines, Inc., and both are subsidiaries of Sun Oil Co. J. Edgar Pew, 1608 Walnut St., Philadelphia, is president of all three.

▶ From a half dozen properties in the Palmetto district, near the Nevada-California line in Esmeralda County, small-scale operations are producing around 300 tons of talc per day and trucking it to distant rail points. The talc is said to be of high quality. The miners have named the new town Talcton.

▶ Construction of a 1,000-ton tailings treatment plant for the Bradshaw Syndicate Inc. has been completed by the Western-Knapp Engineering Co., of San Francisco, at Millers, a rail point 15 miles northwest of Tonopah. Treatment of 2,000,000 tons of silver-gold tailing from Tonopah Mining Co.'s long-dismantled 100-stamp mill will not begin until spring. Mark Bradshaw, of Tonopah, is president and Albert Silver directing engineer.

▶ Bristol Silver Mines Co., with lead-zinc-silver-copper deposits in the Jackrabbit district, north of Pioche and controlled by the Snyder interests, will pay a dividend of 1c. per share on Feb. 10. Development has been extended and for some months the company has shipped around 60 tons per day to a Utah smelter. J. H. Buehler is manager.

▶ Cinnabar showing 20 to 65 lb. mercury per ton upon sampling has been opened in some volume in the Red Bird mine, in the Antelope Springs, or Relief, district, Pershing County, at one time the foremost producing district in Nevada. The mine was taken under option in recent months by Raymond I. Smith and associates, of Reno, who formed the Harold's Club Mercury Co. The company has a 40-ton Cottrell rotary furnace that may be installed. Ore is broken in workings of an upper tunnel and stored in raises driven from a lower adit. During November a single pipe retort, used as a sampler and treating 1 ton per day, recovered 1,100 lb. of mercury.

▶ Consolidated Coppermines Corporation paid a dividend of 25 cents a share on Dec. 19. This brought disbursements for 1941 to 75 cents per share on 1,594,596 shares of $5 par value outstanding.

ARIZONA

Activity Widespread In State

Iron King producing 200 tons per day—The old Swansea to start shipping soon—Postmaster cuts new ore—Clay group of gold placers being worked

▶ The Iron King mine, at Humboldt, has 80 men on its payroll, and is milling 200 tons and shipping 60 tons of crude ore daily to the Clarkdale smelter. The new shaft is down to the 500-ft. level and is to be sunk to 800 ft. Values are in gold, silver, lead and copper. H. F. Mills, of Humboldt, is general manager.

▶ Swansea mine, north of Bouse, expects to start shipping soon. No. 1 shaft has been cleared to the 135-ft. level and ore up to 8 percent copper has been found. Stoping has begun. Swansea Development Co. is operating. E. C. Lane, of Bouse, is president.

▶ Twelve miles northeast of Mayer, the Postmaster mine has opened commercial ore containing gold, silver, lead, and copper on the 200-ft. level. Drifting is continuing and shipments are being made to Clarkdale. Gilbert Mock, of Mayer, is superintendent and has 60 men at work.

▶ The Clay group of gold placers, in the Horseshoe district south of Quijotoa, is being operated by H. R. Espey. Two bulldozers are feeding gravel to an elevator, handling 300 cu.yd. daily. The gravel is 4 to 8 ft. deep.

▶ Union Jesse mine, in the Humboldt district, is shipping a car a month. The property is under lease to Dandea and Burleson, of Humboldt.

▶ Victoria Quicksilver is to start production at once on properties in the Winifred district, 15 miles northeast of Phoenix. High-grade copper and cinnabar ores have been discovered. Work was started last September. Nellie DeVere, 622 East Tyler St., Tempe, Ariz., is owner.

▶ The Trench mill of the American Smelting & Refining Co., near Patagonia,

is treating 200 tons of ore daily, 80 tons coming from the Trench mine and the rest from the Flux. T. A. Sneddon, of Patagonia, is in charge.

▶ The Republic mine, near Dragoon, has started shipping. Principal values are in copper. A small crew is employed. E. J. Ewing and associates, of Tucson, have the property under option.

▶ For six months past the Sugar Bowl, near Cherry, has been shipping a car of gold ore monthly. Present work indicates reserves sufficient for several months. The property is under lease to G. H. Allen and G. S. Purtyman, of Cherry.

▶ Development on the Sitting Bull mine, near Cherry, is under way by S. A. Wardle. A compressor and other equipment have been installed. Work has started on two tunnel levels. The values are in gold.

▶ Producers, Inc., operating a 200-ton custom mill 7 miles west of Chloride, states that the mill is working on a full-time basis and that it expects it to continue doing so.

▶ Davenport Mining & Reduction Co., 15 miles north of Kingman, has shipped its second car of concentrates from its rebuilt mill at the Oro Plata mine. The company controls this and the Idaho and Little Golconda properties. Considerable ore is stockpiled. A close separation of the zinc is being made, this also improving the gold, silver, and lead products. Ogden C. Chase, of Las Vegas, Nev., is president.

▶ E. E. Bethel, owner of the Tia Juana mine, near Patagonia, announces that Seattle interests have taken the property over and are putting it in condition. Road work has been done and equipment is being installed.

▶ A hoist and compressor have been installed at the Penfield mine, in the Cherry Creek district. A 100-ft. shaft is to be sunk. Roy Cornett, of Cherry, is owner.

▶ A concentrator is to be installed on the tungsten deposit recently discovered at Twin Buttes, near Tucson, by Miguel Serasio, who expects to be shipping soon.

▶ A 50-ton mill with jigs and table is handling dump material containing lead, silver, and copper at the B. & R. Mines, Inc., in the Alto district, near Patagonia. The shaft is being retimbered. A small crew is employed. Harry Brunswicker, of Nogales, is owner.

▶ The Silver Reef mine, 15 miles south of Casa Grande, is shipping two cars of ore monthly to the smelter. The property, owned by the Greenhorn Mining Co., is leased to Albert Forbach, of Casa Grande.

▶ Properties operated by the Silver Plate Mining Co. in the Verde district, near Jerome, are shipping to the nearby Clarkdale smelter. The values are chiefly gold, but copper is showing at the 150-ft. level, where water is met. The properties include the Green Monster, Gibbs-Kingdon, and Verde Combination. James M. Layman, of Jerome, is manager.

▶ Shylock Mining Co. is dewatering the old 1,000-ft. shaft of the Shylock mine, northwest of Cherry. The old levels are being sampled and ore bins built. Samuel Rohe, of Prescott, is secretary and manager.

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▶Jaw Plates, when made by Joliette Steel Limited, are always made of Joliette Austenitic Manganese Steel.

▶This steel is of the highest quality and when shipped it is tough but only moderately hard, but it possesses, as do other Manganese Steels of the same class, the peculiar characteristic of hardening on the surface when rolled or pounded.

▶Consequently, a wearing part such as a jaw plate made of Joliette Austenitic Manganese Steel will be found in service to have a thin surface of dense, hard, wear-resisting metal and underneath this hard surface a body of softer, tough metal which resists shock and in so doing prevents cracking. As the hard surface wears away, a new one is formed by the pounding so that a new, thin, dense, hard, wear-resisting surface is constantly being created.

▶In actual crusher tests, it was found that the life of jaw plates of Austenitic Manganese Steel, measured in tons of stone crushed, was about 10 times that of jaw plates of Carbon Steel and about 5 times that of jaw plates of Alloy Steels whose initial hardnesses were much greater than that of the Manganese Steel.

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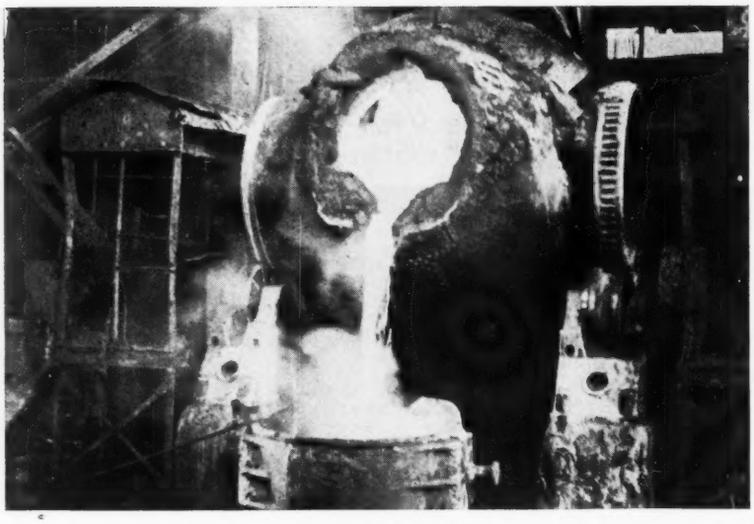

Discharging molten copper from a Great Falls type converter at the smelter of the Magma Copper Co., Superior, Ariz.

UTAH

State's Copper Production Increasing

Vanadium Corporation's Monticello plant to be ready next July—Mercur Dome speeds development work—Bristol Silver declares first dividend

▶ War industry needs, which have stimulated metal production in Utah, recently brought another undeveloped resource into the spotlight. A. S. Brown, chairman of the State Publicity and Industrial Development Commission, states that the $1,000,000 ore-treatment plant of the Vanadium Corporation of America at Monticello will be ready by July 1, 1942. Twenty-five employee houses are being built. When completed, the plant should produce about 60 percent of United States' needs. Construction is being financed by the Federal Government.

▶ Tintic Standard paid a dividend of 5c. a share, amounting to $57,004, or a total of 20c. for the year, as compared with 22½c. last year. The grand total amounts to $18,437,041.

▶ Utah properties, chiefly the Utah Copper mine, produced 200,239 tons of copper during the first nine months of 1941, compared to 231,864 tons for 1940, according to a Bureau of Mines report.

▶ New drilling equipment installed by Mercur Dome Gold Mining Co. at Mercur will enable the crew to reach their objective, the Madison limestone, within 90 days. Shaft depth is about 800 ft.

▶ Snyder Mines, Inc., is employing more than 100 men at the old gold camp, Mercur. About 15,000 tons of low-grade oxide ore is being treated each month in the cyanide plant and 3,000 tons of direct shipping ore produced. The Geyser Marion Gold Mining Co. is employing 40 men.

▶ Silver-lead ore is being mined by New Cashin Mines, Inc., just over the line in western Colorado from LaSal, Utah. The ore will be hauled 90 miles to Thompsons, Utah.

▶ Bristol Silver Mines, Inc., declared its first dividend, amounting to one cent a share, payable Feb. 10. The company operates mines at Pioche, Nev. Total disbursement will be $28,186.66. Output averages 1,900 tons monthly. J. H. Buehler is superintendent.

COLORADO

Cripple Creek Shipments Show Improvement

Debris in Carlton tunnel from Portland connection being cleaned up—Many attracted to school in surveying and geology established at Cresson mine

▶ Gross value of the first nine months' shipments from Cripple Creek was $3,280,407, exceeding the figure for the same period of 1940 by $230,000. Average value per ton has been less.

▶ Clearing of the debris in the Carlton tunnel resulting from the final shot that drained the waters from the Portland mine is progressing. About 1,200 ft. of track remain to be laid. A strong draft is coming down through the Portland mine and ventilation pipe and power cables are being removed. Water flow still exceeds 6,500 g.p.m. per minute.

▶ Two nights a week and all day Sunday some 70 or more men are taking a course in mine surveying and geology at the new office building of the Cresson mine, at Cripple Creek, this under the direction of the Colorado School of Mines. The course is given by Parks Van Dolah and Adin Marshall. Those enrolled include practical miners, who desire to know something about surveying and minerals; bank clerks, accountants, and some engineers who are reviewing their technology.

▶ The Alta Mines, at Ophir, under Marvin Katzenstein, superintendent, are mining and milling 150 tons daily. Gold, silver, copper, lead, and zinc values are recovered by flotation. The property is at 12,000-ft. elevation.

▶ Charles Higgins, of Silver Cliff, leasing on the Defender silver-lead mine, recently shipped three truckloads of ore to the Leadville smelter.

▶ The preliminary program at the Ruby tungsten mine in the Silverton district is under R. B. Moyle, of Ely, Nev. Additional equipment is being installed. Drifting on the vein is continuing and a new low level will soon be opened to develop the ground below present workings.

▶ The new mill being built by P. G. Milligen and associates east of Idaho Springs is being equipped for both flotation and cyanidation. The plant is conveniently situated to take ores from Gilpin and Clear Creek counties. Silver Tip-Gold Crown Mining & Milling Co. plans to install a 200-ton flotation plant. J. H. McClellan is general manager and G. C. Hicks, of Ouray, superintendent.

▶ Eighty men are employed at the Slide Mines, Inc., Boulder, and the values in gold, silver, lead, and copper, as well as tungsten, are said to continue good. J. H. Rodgers is manager.

▶ Empire Zinc Co. of Colorado has reopened its zinc-oxide plant at Cañon City. It is also shipping 500 to 600 tons of copper-silver ore daily to Utah and operating its underground mill at Redcliff.

▶ Development is under way on the American Eagle property on Bull Hill, Cripple Creek. The work is being done through the Burns shaft. The property, leased by the Golden Conqueror from the Stratton Estate, is under the direction of A. W. Deener.

▶ Development work at the Gold Coin shaft of the Golden Cycle Corp., at Victor, is planned to open the New Market vein in the upper levels; a compressor and gas hoist have been installed.

▶ About 350 tons of feldspar is being mined daily by the Colorado Clay & Mining Co., in Jefferson County. The lease is held by John Owens, who is mining by the open-pit method. J. G. Clark is secretary and general manager, and Carl Belser consulting engineer.

▶ W. A. Kyner has opened the School Section mine, at Cripple Creek, and is doing development on the second level: a compressor has been installed and actual mining started.

▶ A 300-ft. drainage tunnel is being driven into the Good Hope mine, in the Beartown district, Silverton, by T. H. Cornelius and F. F. Sherman. Shipments have been made to Leadville.

▶ Gold, Silver & Tungsten, Inc., at Boulder, has been unwatered, the lower level cleaned up, and mining started on the tungsten orebody that was discovered just before the previous shutdown. The vein is said to be 4 ft. wide, with 18 in. of mill ore.

▶ G. A. Snook, of Pagosa Springs, is working the May Day mine, near Hesperus, single-jacking with hand steel, and producing about one ton of gold-silver ore daily. Two men are employed. This mine has been operated intermittently for years.

▶ A five-year lease on the Ben Harrison

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Empire State shaft of the Empire Lee Mining Co., Cripple Creek, Colo. Ten sets of leasers are producing about 200 tons of gold ore per week from this property. The snow-capped mountain in the background is Pikes Peak

▶COLORADO

and Croesus has been given to John Mollard, Jack Mollard, George Callaway, and R. M. Calvert, who will operate them through the 260-ft. shaft. This will be retimbered and a 500-c.f.m. compressor installed. These mines adjoin the Lamartine and embrace about ten acres of mineral ground.

▶ J. Collins and R. Mestas are shipping steadily from their lease on the 470-ft. level of the Melvina mine, near Boulder. The stopes are narrow and a correspondingly narrow scraper is being used in slushing to the mill holes. H. M. Gregory, owner, is erecting a small cyanide mill near the main shaft.

▶ E. D. Brooke is sinking from the bottom level of the Ella C. on the main oreshoot. This property is near Boulder.

▶The Buckskin Joe mill, at Alma, is working two shifts, under Charles W. Jordan, manager, and Walter Snell, mine superintendent. This property was leased from the Key Test Mining Co. Thirty to forty men are employed.

▶ Florado Mining Co. is operating its mill at Montezuma, under G. W. Lavender, superintendent. Work is also being done by lessees, under the partnership operated by Earl Sullivan and Chester Alexander.

▶ The Mary Nevin mine of Gold Empire, Inc., will now be worked on company account. The shaft will be retimbered, a 2-ton skip and a larger hoisting plant installed. Extensive plans for its operation include the Henry Adney and Fountain Valley. For the past two years the property has been leased, until development could be completed and money provided for building a mill to treat the low-grade ore available. Contract with a Denver group provides for treating 500,000 tons or more in the Rosebud mill near the Mary Nevin shaft. Fountain Valley and Mary Nevin mines have been developed recently to 50-ft. levels. The Henry Adney has much milling ore in the shallow workings, and has been developed to 700 ft., most of the 1,500,000 tons mined having come from above 500 ft.

▶ A shoot of gold ore has been struck in the breast of the Little Johnny tunnel, where Griswold and Stromberg have been drifting towards the Emancipation; a stope 50 ft. long is being prepared.

▶ At Cripple Creek, the Ajax is mining on the 25th, 26th, and 27th levels. Shaft sinking is now below the 27th level and is continunig. Station work on this level is now complete.

NEW MEXICO

▶ The Navajo Fluorspar Co., organized following the discovery of fluorspar in northwestern New Mexico, by two graduates from the New Mexico School of Mines, is now operating the new plant. The company is a partnership composed of James Mallery, Box 1111, Grants, N. M., and Vernon Taylor, Jr. The mineral deposits, are said to have a substantial tonnage blocked out, with three years' supply in sight. The mill is at Grants, Valencia County, N. M.

IDAHO

Coeur d'Alene District Has Active Year

Four new plants completed during 1941, bringing daily milling capacity close to 10,000 tons—Sunshine Consolidated developing promising vein on 3,100-ft. level.

▶ The Coeur d'Alene mining district now has milling capacity of 9,600 tons daily, the largest in this history of the camp. During 1941 four new concentrators were completed, with a total capacity of 1,500 tons daily, the largest increase in any one year in the history of the district. A new mill was completed at the Tamarack & Custer and the Sherman mines in the Burke district and a plant was built at the Dayrock on Nine-Mile and at the Coeur d'Alene Mines Corp. property in McFarren Gulch, the latter a 600-ton daily run mill. Older mills in the district are four mills operated by the Bunker Hill & Sullivan, with 2,300 tons' capacity; Sunshine Mining Co., with a 1,000-ton plant; Morning mine of the Federal, with 1,500 ons; Hunter mine, with 500 tons; Star, 800 tons; Hecla, 800 tons; Polaris, 200 tons; Jack Waite, 300 tons; Crescent (Bunker Hill) 100 tons; Silver Crescent, 125 tons; Page, 300 tons; Golconda, 300 tons; Galena, 200 tons. In addition the Pine Creek belt has three mills totaling 700 tons' daily output which are ready to go into action when zinc prices warrant. They are at the Highland-Surprise, Little Pittsburg, and Constitution properties.

▶ The Sunshine Consolidated property, worked through the deep levels of the Sunshine's Jewell shaft, reports an important ore disclosure on the 3,100 level, where a drift had been extended on the vein for 450 ft. The ore is said to show 4 ft. in width, carrying high silver values. The vein is known as the Yankee Girl, a parallel vein to the Yankee Boy, source of the main ore supply from the Sunshine mine. Ore from the Sunshine Consolidated will be treated in the 1,000-ton milling plant of the Sunshine.

▶ Tungsten will become an important product from the Atlanta group of claims owned by the Talache Mines Co., in Elmore County, according to an announcement by A. H. Burroughs, Jr., president. The Atlanta is Idaho's chief gold producer and has been operated for many years. Tungsten-bearing ore was disclosed the past summer on the Monarch side of the Atlanta hill, and further exploration has revealed ore in commercial quantities. The Boise-Rochester mill of the company is being remodeled to treat the tungsten ore.

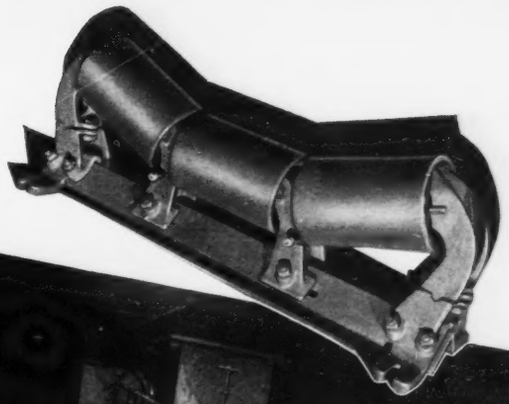
▶ The Liberty Gold Mining Co. has purchased the milling plant of the Grangeville Gold Co. and will move the machinery to the Sultan Gold property near Elk City, in central Idaho, according to a report by officials. Matt Thieltgrass, president of the Liberty, says his company has completed 300 ft. of a proposed 1,100-ft. tunnel to open the Sultan vein at greater depth.

▶ The first car of calamine, or silicate of zinc, ore ever shipped out of Custer County, in eastern Idaho, is reported to have been received at the International smelter, in Tooele, Utah. The shipper was F. D. Sherry, mining man of Mackay. Two cars a week are said to be the plans of the owner. Several other properties in Custer County report a tonnage of similar ore, which will be prepared for shipment.

▶ Sullivan Mining Co., owner of the electrolytic zinc plant at Kellogg and the Star mine, at Burke, will distribute profits of $1,000,000, payable half to the Bunker Hill & Sullivan and half to the Hecla Mining Co., joint owners in the enterprise. The zinc smelter is now using 450 cells in its operations, from which zinc of 99.99 plus is supplied to the trade. About 400 men are employed at the plant, which represents an investment of more than $4,000,000.

▶ All major mining operations in the Coeur d'Alenes are on a six-day week basis, with time and half paid miners for the extra day. Milling and smelting plants operate on a continuous 24-hour basis.

▶ The St. Elmo Silver Mines Co., officials have announced plans for an 800-ft. shaft, to be sunk from a point near the face of the deepest tunnel level. The property



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▶IDAHO

joins the Coeur d'Alene mines group on the east. The shaft is expected to cut the vein at about the 500-ft. level.

▶ The Morning and Page mines of the Federal Mining & Smelting Co. were closed from Dec. 19 to 29 while the employees were given the ten-day vacation with pay, as granted in recent union settlements. Shaft repair men, pump men, and other necessary employees were kept on the job and repair work was carried on in various sections of the mines.

▶ The Grimes Pass Power Co. has completed installation of a power line to George Schumann's property at Pioneerville, central Idaho. Electric motors are now being placed at the property. The mine has been shipping steadily to Utah smelters.

▶ Crown Consolidated Mines Co. is developing an antimony property near Ketchum and reports new ore disclosures at a depth of 200 ft. Steam power is being replaced with a diesel-electric plant and operations will continue through the winter months.

WASHINGTON

Manganese Ore Shipped From Crescent Lake

Mines in Metaline district go on seven-day basis to boost output—Sodium sulphate being mined near Brewster—Azurite Gold ships high-grade ore

▶ Crescent Lake manganese property on the Olympic Peninsula has made an initial shipment of 1,000 tons of high-grade ore. Rowland King, representing the Sunshine Mining Co., is developing the property.

▶ Mines in the Metaline district have gone to a full seven-day basis in response to the Government's urgent demand for zinc and lead. The two operating companies are the Pend Oreille Mines & Metals Co. and the Metaline Mining & Leasing Co., a subsidiary of American Zinc, Lead & Smelting Co.

▶ Washington Chemical & Salt Co., successor to Washington Chemical Co., is developing its sodium sulphate property on the Okanogan River, 7 miles from Brewster. The sulphate is dug with power equipment from dry lake beds, dissolved in water, and filtered and recrystallized.

▶ Azurite Gold Co. shipped two cars of high-grade ore recently to the Tacoma smelter. They contained 74 tons and yielded 81.2 oz. gold and 83 oz. silver, valued at $2,616. The ore came from a new stope on the 1,050-ft. level.

▶ Arthur Simonton, of Leadpoint, Wash., recently sold to Ralph Davis, mine operator of Oregon and Montana, the Electric Point mine, in northern Stevens County, for an ultimate consideration of $51,000. Two payments have been made. Mr. Davis has opened up a cave 75 ft. long by 40 ft. wide by 40 ft. high in searching for new chimney of high-grade ore. Lead ore forms its walls, roof, and floor. A tunnel is being run to tap it at a lower depth.

▶ Mining men of northern Stevens County met at Kettle Falls in December to discuss the development of the region's mineral resources. John Marty was in charge and representatives from Northport, Orient, Colville, Chewelah and Nespelem were present. They expressed the belief that a plant in the district to treat lead ores by using power from Grand Coulee dam would be successful.

▶ Kromona Mines Co. will explore a vein of copper-silver ore 600 ft. above the base of the Sultan basin in Snohomish County. Outcrops give samples yielding 4.4 percent copper. The property is to be opened with a long tunnel.

▶ Big Lake Mining Co. has been organized in Spokane to develop a property in Ferry County, on the shore of the newly formed Columbia River lake. The property consists of nine claims traversed by two parallel veins outcropping 3,000 ft. along a granite-schist contact. Two shafts have been sunk, one to a depth of 150 ft. Will Everett, president, says the vein has been found to be 6 to 12 ft. wide. A crosscut tunnel has been driven 660 ft. to secure a depth of 400 ft. The tunnel portal is 600 ft above the new lake formed by Grand Coulee Dam. He reports that the ore carries 0.08 oz. of gold, 19 oz. of silver, 21 percent lead, and 5 percent zinc.

ALASKA

Gold Dredging Active During 1941 Season

Up to 28 boats have been in commission on Seward Peninsula, including U. S. Smelting's newest unit — Bridge across Tanana planned for Big Delta

▶ Twenty-eight gold dredges were operating in 1941 in the Seward Peninsula area, according to Howard Lyng, of the Alaska legislature. He places the dredges as follows: Ungalik River, 2; Dime Creek, 1; Council district, 5; Solomon River, 2; Nome, 7; Teller district, 2; Kougarok River, 2; Imnachuk River, 3; Iron Creek, 1; American Creek, 1; Candle district, 2; total 28. Included is the new dredge of U. S. Smelting, on Holyoke Creek, near Nome.

▶ In the Sixty-mile district, Holbrook Dredging Co.'s operations have been suspended for the season and the crew has gone out. Idaho-Canadian Dredging Co. expects to have its dredge on Big Gold Creek in operation by next fall. The latter company bought its dredging ground from William Williams, pioneer operator in the district, the holdings consisting of 7 miles of virgin ground. A diesel caterpillar has arrived. Harold Young is dredge superintendent.

▶ John Kazinsky will operate his father's placer ground this summer on Last Chance Creek, in the Dawson district.

▶ Work done last summer in the Nome

district, according to Woodbury Abbey, uncovered good placer ground, which will be worked this year by a new dragline enterprise. Near this ground is the large new dredge installed the past season by the U. S. Smelting company.

▶ General Simon B. Buckner, Jr., U.S.A., has endorsed plans for a bridge over the Tanana River at Big Delta to take the place of the ferry used for 25 years. He says it is needed for military purposes, but it also will be of benefit to mining men.

▶ A moratorium on assessment work on mining claims for the duration of the war was advocated by the Alaska Miners' Association at its last meeting in Seattle, on the ground that it was needed because of the shortage of available labor.

▶ One outfit is producing about one flask of quicksilver a day with home-made equipment near Sleitmut, in the Kuskokwim district. Mellick and Halverson, who have this operation, have been so successful that there is much prospecting in that valley. Retorts were shipped last year to the Bluff section and to the Hudson project in the Livengood district.

MICHIGAN

Assessment Method Unchanged

Procedure this spring will be much the same as heretofore—Champion copper resumes after brief shutdown from fire—Kearsarge No. 4 to be reopened

▶ Calumet & Hecla will reopen the North Kearsarge No. 4 shaft. Announcement followed negotiations with the OPM. A contract will be drawn up with the RFC, specifying a price of a cent per pound over out-of-pocket costs. Actual mining cannot begin for three or four months, as necessary preliminary work is extensive. Employment of underground men will be gradual. Repair work and installation of new surface equipment will start at once. Contracts may be negotiated later covering other Kearsarge amygdaloid shafts. The reclamation plants are operating continuously and mining at Ahmeek is at capacity.

▶ Underground operations by Copper Range at the Champion mine were resumed Dec. 11 after being suspended since Nov. 22, when fire broke out in the abandoned No. 1 shaft where men were reclaiming old equipment. The fire was not widespread but filled the active workings with smoke and gas. It finally was subdued and the remaining gas driven out through the old Trimountain openings.

▶ John P. Libcke, chairman of the Michigan Tax Commission, has stated that no immediate change in the method of assessing Upper Peninsula mineral properties will be recommended by the special study commission of which he is a member. Assessed valuation of the properties will be determined next spring, he said, in about the same manner as heretofore. The Governor had appointed the study commission following a controversy over assessment of certain iron mines. A formal report will be submitted in about two months.

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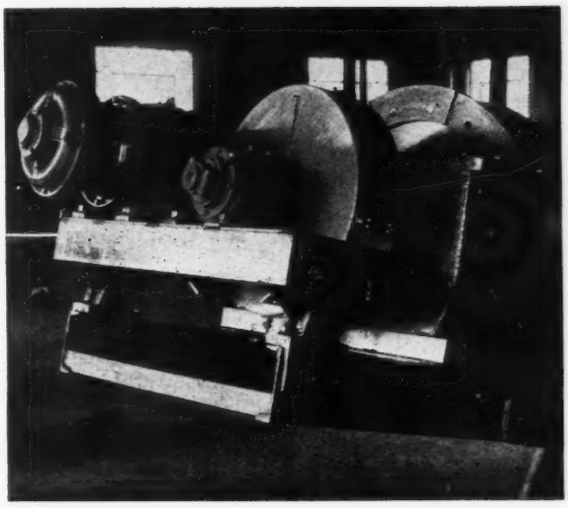

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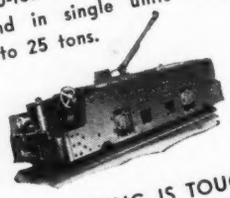

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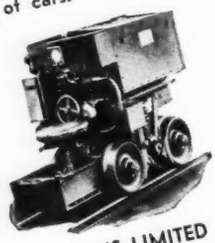

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IRON COUNTRY

New Record Established For Lake Ore Movement

Rail shipments slated for this winter—Minnesota grants new permits to explore State-owned lands — Evergreen Mines widening its operations

▶ Iron-ore shipments from the Lake Superior region ceased Dec. 8 with the departure from Duluth of the steamer "Bethlehem." A total of 80,111,745 gross tons was shipped to Lower Lake ports from April 8 to Dec. 8. The former peak season was in 1929, when 65,204,600 tons went down the Lakes. This record will be hard to surpass, as all mines were operating at capacity and weather conditions prevailing both on the Lakes and on the iron ranges during the latter part of the season were excellent. October was the only month in which a new high in monthly tonnages shipped was not made and that was due principally to the delay caused by the collapse of the railroad bridge at the Soo canal. Of the total shipped, Minnesota alone contributed 63,255,584 tons, with almost 50,000,000 tons coming from the Mesabi.

Mesabi Range

▶ The State of Minnesota recently granted permits to several mining companies for exploration of State-owned lands containing approximately 7,000,000 tons of ore. These permits were granted as follows: The Congdon Longyear Reserve, near Keewatin, containing 2,000,000 tons (concentrated) of ore, to Butler Brothers, of St. Paul. The Buckeye Reserve, near Coleraine, with 1,000,000 tons to the Evergreen Mines Co., Crosby; and the Carson Lake mine, at Hibbing, with 4,000,000 tons of merchantable ore to the Charleson Iron Mining Co., of Hibbing.

▶ Evergreen Mines Co., Perry G. Harrison, of Crosby, Minn., president, is expanding its iron mining activities considerably. It has leased the Maroco mine, on the Cuyuna range, and started to build a concentrator. A stripping program, involving about 400,000 cu.yd., will be undertaken to make possible a production of approximately 200,000 tons in 1942.

This company has also leased the Pettie Reserve, at Chisholm. A 400,000-cu.yd. stripping program has been begun and production will start early in 1942. The company is also investigating a mineral deposit in Fillmore County, Minn., near the Iowa border, in a farming region where deposits of low-grade iron ore have been found.

▶ Pickands, Mather & Co. has recently let a contract for approximately 1,000,000 cu.yd. of stripping at the Dunwoody mine, at Chisholm. It has also started to sink a shaft here to facilitate mining.

Marquette Range

▶ Mining operations resumed at the Greenwood mine of the Inland Steel Co. Dec. 15, following installation of a new headframe. Mining was suspended on Nov. 18. R. L. Wahl is mine superintendent of the company.

▶ The Marquette Range Industrial Union, with a large membership, has entered into labor contracts with Cleveland-Cliffs Iron Co., the Cliffs Power & Light Co., Athens Mining Co., and the Negaunee Mine Co. The Negaunee company operates the Negaunee and the new Mather mine property. Under the terms of the agreement, the Range union serves as sole bargaining agent for the men working at the mines and other properties operated by the companies named above. To obtain this right the union must have 51 percent of the employees at any property signed up as members. In one of the companies the percentage of workers enrolled is 97 percent. The agreement will be in force for one year and covers wages, working hours, vacations, seniority privileges and other articles of mutual interest.

Menominee Range

▶ Sinking of the Bates shaft may be undertaken by the M. A. Hanna company. Iron River, Michigan. S. E. Quayle is general superintendent.

▶ Pittsburgh Coke & Iron Co. is sinking a new shaft at its Davidson property at Mineral Hills, in the Iron River field, to replace the Davidson No. 1 shaft.

ARKANSAS

Small Zinc Mines Busy In North Arkansas

Several properties are maintaining steady production

▶ The 60-ton mill at the Excelsior mine, near St. Joe, Ark., operated by the Hurricane Mining Co., is in steady operation. The main shaft at the property has been sunk to a depth of 75 ft., with ore averaging 10 percent zinc being mined from four drifts.

▶ Two new shafts have been sunk on the Bald Hill mine, near St. Joe, Ark., and development of zinc carbonate ore continues. One shaft is 80 ft. deep; the other about 70. The mill at the Bald Hill mine has a capacity of approximately 50 tons a shift.

▶ The Lucky Dog mine, near St. Joe, Ark., owned and operated by the Rock Creek Mining Co., is operating a 75-ton mill, producing a high-grade zinc concentrate. Ore is produced in a tunnel driven into the side of the mountain. The ore face is about 8x40 ft. and contains around 6 percent zinc. The property is under the management of N. J. Andrews, of Joplin, Mo.

▶ The Edith mine, at Rush, Ark., in Marion County, has a new 100-ton mill under construction, which is expected to be in operation early in January. Ground operations have been conducted at the Edith for over a year, and the zinc carbonate ore has been stockpiled.

▶ The Manda Corp., of Harrison, Ark.,

which buys most of the ore produced in the field, has installed a crushing plant at its ore docks on the M. and A. Railway in Harrison. The corporation purchases a large tonnage of free carbonate, and for a long time had trouble in getting accurate assays in chunk form. All of its purchases of this class ore are now run through the plant, which consists of a jaw crusher and a set of rolls. Most of the ore is shipped to Detroit, Mich.

▶ The Washington office of the Arkansas Agricultural and Industrial Commission has announced to Governor Adkins through it's director that the R.F.C. will make loans for the development of strategic and critical minerals in Arkansas. The director of the Washington office, H. K. Thatcher, has been working with L. A. Watkins, president of the Missouri and Arkansas Railway Co. The purpose is to develop minerals such as aluminum, zinc, manganese, lead, graphite, iron, and mercury. These loans are for owners of property and will not be made to purchase property or for prospecting. Loans will not be made to persons holding leased property unless the owners of the property agree to give the R.F.C. a mortgage on the property. Owners will be required to subordinate all land and royalty payments to the R.F.C. loan, which is at 6 percent.

TRI-STATE

Zinc-Mine Operators Review Year's Activities

Tri-State Zinc and Lead Ore Producers Associations declare "all-out" zinc production for duration—Some properties being rehabilitated

▶ A declaration for "all-out" zinc production on the basis of a broad, sound economic policy for the duration was voiced by leading mine operators at the annual meeting in December of the Tri-State Zinc and Lead Ore Producers Association, which was held during the week that marked the entry of the United States in the Second World War. Opposing in general any form of subsidy, the producers advocated an outright market price that would permit them to turn to lower-grade ore reserves of the field in order to at least maintain, if not increase, the present rate of output. A sharp increase in price to obtain more production was advocated by one major producer on the premise of stockpiling, if for no other reason than to cope with any shortage that might arise, such as in the event of a discontinuance of water transportation in the shipping of ore to this country from foreign sources. It was pointed out that an $80-a-ton concentrate price, based on 12c. metal, would permit the mining of 3 percent ores on a break-even basis, and that such a price would be an incentive for speculative investment, which is the primary requisite in extending the life of any mining field or the development of a new one. The importance of a higher price to offset any and all increased costs, particularly higher wages for labor, so that the latter could be kept at their jobs in competition with those of other essential

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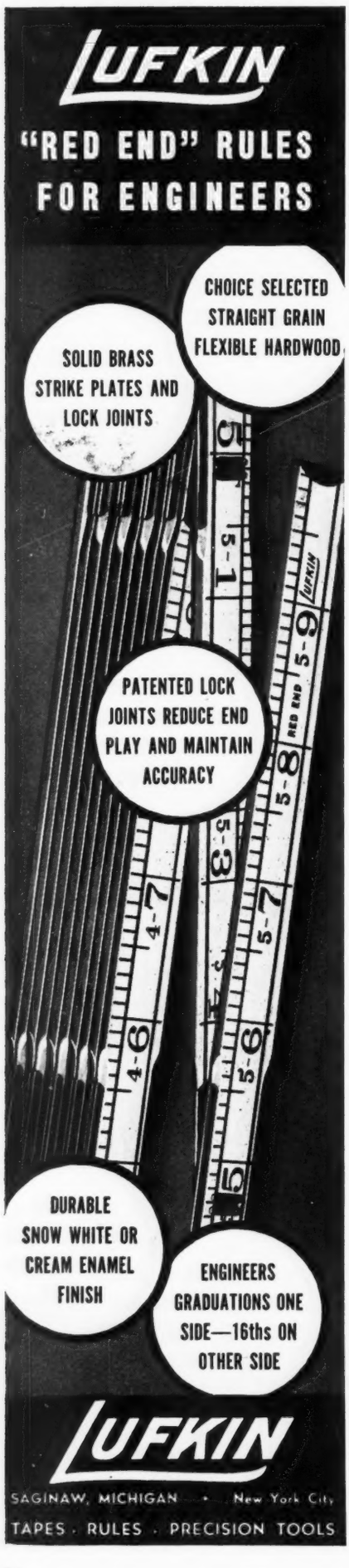
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defense industries, also was emphasized. Accomplishments of the zinc industry in meeting the demands of the national defense program during the year were reviewed by Howard I. Young, of St. Louis, president of the American Zinc Institute. Ernest V. Gent, secretary of the Institute, told of activities leading up to the outbreak of the war and a report of associational work was made by Secretary Evan Just, of Miami. The following officers of the ore producers' association were reelected: John A. Robinson, of Miami, president; George W. Potter, of Joplin, first vice president; Victor C. Allen, of Joplin, second vice president; L. G. Johnson, of Baxter Springs, treasurer, and Evan Just, secretary. R. O. Gibson, of Miami, and John J. Inman, of Joplin, were named directors, succeeding the late C. F. Dike and the late G. W. Johnson, both of Joplin. Other directors are Charles A. Neal, Charles A. Beck, and S. L. Kenney, of Miami; Sam Ashe, of Cardin; H. H. Hartzell, H. H. Utley, and O. W. Bilharz, of Baxter Springs, and D. G. Harrison and Paul Childress, of Joplin.

▶During December, the Skelton Lead & Zinc Co. suspended milling operations at its mill on the 200-acre Mary Calf allotment near Douthat, and began to ship ore to the Eagle-Picher Central mill for treatment.

▶Late in December the Jane E. Mining Co. resumed operations at the old Century Zinc mill on the Scott lease, a mile east of Hockerville, which had been idle since October, 1940, when the company began the shipment of ore to the Eagle-Picher Central mill. J. L. Nelson, of Baxter Springs, is superintendent of the Jane E. Co.

▶The Chitwood tailing plant of the Missouri Mining Co., a subsidiary of Tri-State Zinc, Inc., was rehabilitated during December and placed in operation, according to Victor C. Allen, of Joplin, general superintendent of the companies. The plant, which had been idle since March, 1938, underwent a general overhauling preparatory to the resumption of operations. Its capacity is between 50 to 60 tons of tailings an hour. Harry Keyes, of Oronogo, is mill foreman.

▶A test run of ore from the newly opened Bailey mine of Fred Childress & Sons near Galena was made at the Eagle-Picher Central mill during December. Blende recovery averaged around 6 percent for several hundred tons of ore treated, which was hauled over the Frisco lines to the mill in Oklahoma.

▶The Weidman Mining Co. has taken over the operation of the Woodchuck mine and mill, south of Cardin, and the Townsite mine, in Cardin, all of which were formerly operated by the Oklahoma Interstate Mining Co. H. G. Weidman, of Baxter Springs, manager of the Dines Mining Co., is in charge of operations. At a reorganization meeting earlier of the Oklahoma Interstate company, which became a holding company, Herbert H. Blizzard, of Philadelphia, was elected president, succeeding the late C. F. Dike, of Joplin. Other officers named by a new directorate were L. H. McColgin, of Joplin, vice president, and T. W. Hill, of New York, secretary-treasurer. Henry Aspoas, of Joplin, and H. D. Knox, of New York, were elected directors in addition to the officers named.

▶Lawyers Lead & Zinc Co. has reopened the old Midas shaft north of the company's New Chicago Lease No. 2, according to George O. Pearson, of Joplin, secretary-treasurer of the company. Mine operations are on at the 243-ft level. Ore is being treated at the company's mill.

▶The Lula Bell Mining Co. is sinking a new shaft on the company's Opperman lease, southwest of Baxter Springs. A shaft, will be sunk to the 200-ft. level, for ventilation purposes. The company also reopened the No. 1 shaft on the Farmington lease at Hockerville. Ore from the Farmington and Opperman mines is treated at the Lula Bell mill, at Hockerville. Dick Wills, of Miami, who is interested in the company, has succeeded John Reigart, of Baxter Springs, as mine superintendent of the company.

MEXICO

Advent of War Tends to Check Labor

Miners' union pledges loyalty to Government—Metal production for first eight months up with some exceptions—Cooperatives warned to obey safety regulations

▶War is having a direct effect upon mining in Mexico. Labor trouble seems to be out for the duration. The national miners' union was one of the first units of organized labor in the country to pledge unqualified loyalty to the Government and to President Camacho. Already, many companies and individuals have arranged to step up their outputs, particularly of silver and copper, though grumbling is heard from some of the lead producers.

▶A stir has been caused by the complaint of the national miners' union to the Labor Ministry that several companies are using their refusal to employ workers suffering from fibrocosis and those who show signs of that malady as an excuse for hiring young men only. The union hints that the companies prefer youthful workers because they can be made to be more obedient than experienced men. Some companies have petitioned for an amendment to the mining labor law to exclude victims of fibrocosis from employment, on the ground that these men must inevitably be dismissed and heavy compensations paid them.

▶Most of the lead companies in Chihuahua, Coahuila, and Durango have joined those of Nuevo Leon in urging President Camacho to lift or at least suspend the extra 12 percent tax on their metal exports. They aver that the war is of no benefit to them, because of low market prices and high operating and tax expenses. If relief is not forthcoming, they warn, most of them must quit and those that keep going will be able to do so only on a limited scale.

▶Cananea Consolidated, in Sonora, will apparently be able to proceed unobstructed with its program for increasing

production, now that an agreement has been made that allows its employees expanded free medical and medicine services and some minor concessions.

▶ Cooperative societies have been warned by the Labor Ministry to obey safety regulations strictly, following several serious accidents in such workings. The Ministry is exercising closer watch over all mines as part of its program to curb accidents.

▶ Troop protection for the cooperative that is working at Coyuca de Catalan, Guerrero, has been asked by the representative of this organization, the Cooperativa de Productores Mineros. Raids by heavily armed gangs are said to have made it impossible for these miners to work the properties they hold under Federal concession.

▶ The Mining School of Mexico, a Federal institution in Mexico City, celebrates its 150th anniversary in January. Government officials and leading men of the industry will attend. Ing. Mariano Moctezuma, dean, will preside.

▶ With the exception of gold, silver, lead, and five of the minor metals, production during the first eight months of 1941 was at a higher level than during the corresponding period of 1940, as shown by the following figures of the Ministry of National Economy (amounts in kilograms):

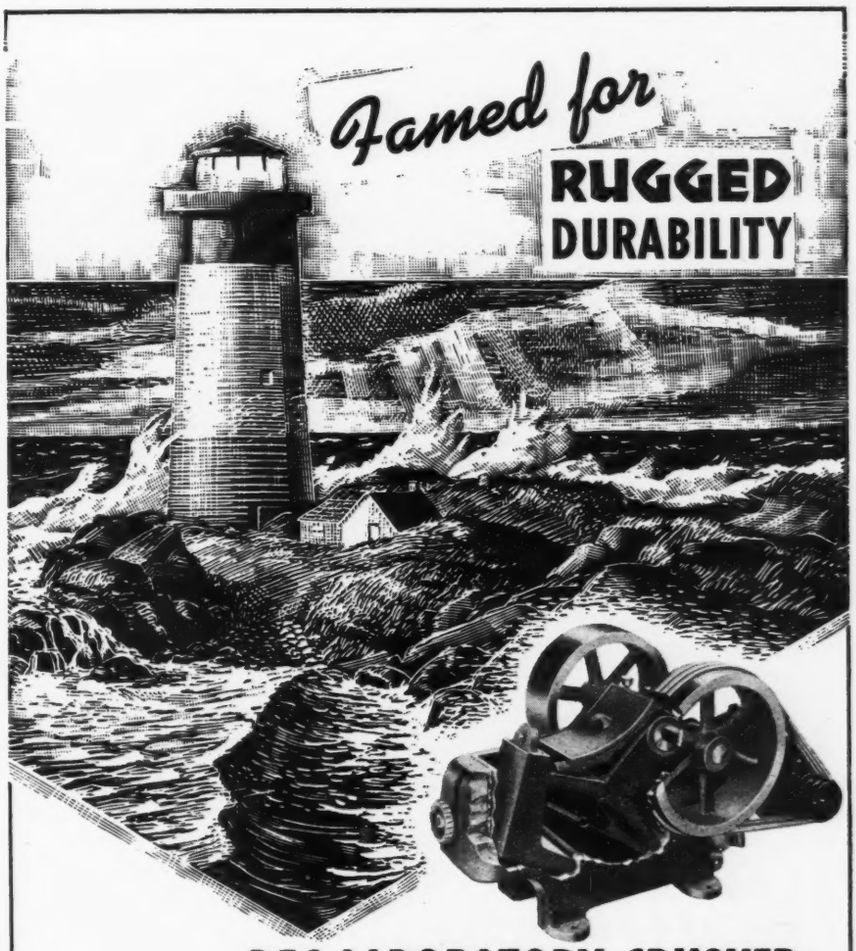
Product	1941	1940
Gold	17,939	19,409
Silver	1,725,287	1,738,331
Copper	34,639,845	25,613,230
Lead	109,100,300	138,362,675
Zinc	81,863,812	75,010,845
Antimony	7,843,754	8,710,661
Graphite	11,643,166	8,152,065
Mercury	618,006	208,160
Arsenic	8,507,818	7,207,930
Cadmium	437,063	563,253
Tin	142,412	222,910
Molybdenum	563,364	397,069
Iron	48,379,145	46,223,272
Vanadium	.....	14,760
Manganese	315,475	234,853
Bismuth	63,826	134,631
Tungsten	59,466	80,150
Coal	552,905,562	580,100,493

▶ Though still below their pre-war level, exports during August, most recent month for which official data are available, showed improvement. The Ministry, reports this movement as follows, amounts in kilograms:

Gold, 598; copper, 4,359,753; antimony, 688,417; cadmium, 33,596; tin, 1,116; iron, 306,476; graphite, 1,135,726; and manganese: 82,386—all to the United States. Silver, 216,210—United States, 216,209; Brazil, one. Lead, 4,626,844—United States, 4,384,779; Uruguay, 212,135; the Argentine, 29,930; Zinc, 12,144,580—United States, 12,063,969; Brazil, 80,511.

Mercury, 24,318—United States, 13,235; Brazil, 5,980; the Argentine, 2,761; Japan, 2,135; and Costa Rica, 207. Arsenic, 1,088,541—United States, 887,994; the Argentine, 200,547. Tungsten, 3,169—Japan, 2,641; United States, 528. Molybdenum: 1,758—all to Japan. During August mercury, molybdenum, and tungsten were still being shipped to Japan by Mexico, though in that month the United States instead of Nippon took most of the mercury shipments.

▶ Troops are guarding all properties of one large metal producer in Mexico as an emergency war measure to prevent sabotage and to assure steady production. All mines are under strict government surveillance.



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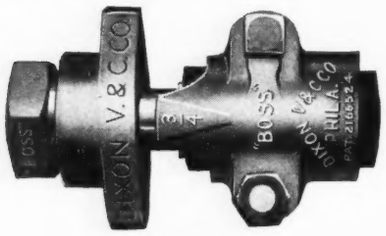

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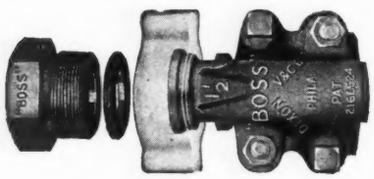

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SOUTH AMERICA

Metals Reserve Buys Brazilian Minerals

Two year contract arranged—Iron ore reserves in Minas Gerais estimated at several billion tons

▶ Recent agreement between the United States and Brazil specified that any surplus of several strategic minerals produced by the country, after American importers have been satisfied, will be bought by the Metals Reserve Corp. The list of strategic minerals includes manganese ores, diamonds, rock crystals, ferro-nickel, bauxite, chromite, beryl ores, mica, rutile, and zirconite ores. All the Brazil's output of these minerals for the next two years is to be purchased by the United States.

▶ In the State of Sao Paulo great attention is being paid to the development of the Ribeira de Iguape Valley mining district. The area is of some 5,000 square miles, strongly mineralized, and comprises several mines of lead, silver, zinc, and gold ores which are being exploited in a small scale. With the completion of the Banhado Grande road, 20 miles North of Apiai, two promising mines are to start operation. The State Geological Survey plans to aid the mining companies, providing an extensive program of diamond drillings in a few mines during the next year.

▶ Exports of rock crystals to the United States will reach this year a new all-time record. In 1941 1,180 tons of crystals were exported during the first eight months of the year, valued at $2,270,000. Total exports last year were only $750,000.

▶ Mica was exported in a larger scale in 1941. In the first half of the year 1,117 tons, corresponding to $800,000, were shipped, most of which went to the United States. Mica mines are found in several states, chiefly Minas Gerais, Sao Paulo, Bahia, Ceara, and Rio Grande do Norte. With better methods of mining, sorting, and grading it is believed that domestic mica can meet the requirements of the United States market.

▶ It is believed United States Eastern steel plants can use the Brazilian high-grade iron ores from Minas Gerais. Reserves of several billion tons of hematite are known in central Minas Gerais. Recently Charles Will Wright, foreign minerals specialist for the U. S. Bureau of Mines, stated that some 1,500,000 tons of Brazil iron ore can be used now in steel industries situated east of the Alleghenies. W. L. Pierson, president of the Import & Export Bank, visited a few months ago the iron mines of the Rio Doce Valley, State of Minas Gerais. He said he and the technologists who have been at the mines with him had a favorable impression about the possibility of immediate exploitation of these mines. Mr. Pierson stated that, as in the past only slight improvements were obtained in exploitation of those reserves, probably the old methods must be discarded and the whole problem of mining, transportation, and shipping studied again.

CHILE

▶ Exports of copper from Chile during the first nine months of 1940 and 1941, in metric tons, according to Mineral Trade Notes, issued by the Bureau of Mines:

	Jan.-Sept. 1940	Jan.-Sept. 1941
Electrolytic:		
United States	120,506	175,248
Japan	9,126	12,771
Sweden	966	.....
Argentina	2,271	7,163
Great Britain	432	.....
Italy	6,483	.....
Brazil	.....	3,455
Peru	9	25
Bolivia	.....	2
Uruguay	.....	100
	139,793	180,764
Standard:		
United States	117,668	136,831
Japan	.....	3,403
France	2,794	.....
Sweden	1,092	.....
Argentina	125	.....
Italy	11,990	.....
	133,669	140,234
In ore etc.:		
United States	3,687	308
Japan	3,478	5,838

Shipments of electrolytic and standard copper to Japan in 1941 were made during the first quarter of the year.

CANADA

Dominion Serving as War Materials Arsenal

Hon. T. A. Crerar, Minister of Mines and Natural Resources, defines Canada's function in war—Several new areas for prospecting located.

▶ Hon. T. A. Crerar, Minister of Mines and Natural Resources, has defined Canada's function in this war as an arsenal for war materials, rather than as a recruiting ground for an invincible army. Plants that employ up to 10,000 men, turning out explosives, shell cases, bombs, tanks, planes, trucks, ships, and other materials, offer the major Canadian contribution to the Allied war effort, he declared. In Kirkland Lake the Toburn, Sylvanite, Wright-Hargreaves and Lake Shore mines were working under a scheme to devote available hours in their machine shops to produce marine reverse engines for the fleet of 9,300-ton ocean freighters being built for the Government. Before the strike, two completed engines had been shipped and the 18 others are now in various phases of production. Work on the different parts to be finished at each mine is continuing, with assembly work undertaken by Toburn Gold Mines.

▶ Several new areas for prospecting were located last summer by survey parties sent out by the Department of Mines and Resources, according to a preliminary announcement. Exploratory work in northern Quebec east of Hudson Bay disclosed rock formations favorable for gold and other metals for a length of 140 miles along the Eastmain River. A second belt of promising structure was found over a length of 45 miles, 11 miles in width, located north of Lake Chibougamau and west of Lake Mistassini. In the Northwest Territories, 100 miles

north of the producing mines near Yellowknife and within 30 miles of Great Slave Lake, two bands of greenstone were mapped. Each of these is larger than the Yellowknife structure where the known gold deposits occur. Three new sections of British Columbia have been indicated as offering excellent chances for prospectors.

ONTARIO

▶A steady dwindling in the ranks of striking miners at Kirkland Lake led more than 40 percent of the men to return to their jobs, five weeks after the walk-out. Operators at the eight mines affected reported on Dec. 16 that 1,314 men were working, out of the 3,947 men who had been employed when the strike vote was taken. These are in addition to the administrative and technical staffs, who were not entitled to take part in the voting. Practically all those continuing on strike are foreign-born. More than 200 of the strikers have called at mine offices for unemployment insurance books and left the camp for good. At Kirkland Lake Gold, the mine was shut down for the first two weeks, while various repair work was done, and the plant was then started up at full capacity of 400 tons daily. Tech-Hughes announced that the 1,200-ton mill, running at half that rate before the strike, would maintain output at about 250 tons a day for the duration of the war. Lake Shore issued an official statement that shows operating efficiency has been disrupted and higher costs will result from the strike. Many of the best workmen have left the camp "in order to get away from the unsettled labor conditions brought about solely by the entrance of the C.I.O. agitators into the district." A conference of fifteen organizations affiliated with the Canadian Congress of Labor was called to form a national council that will support the Kirkland Lake strikers. The program of the Congress of Labor has been to force Ottawa to recognize unions. Premier Mackenzie King declined to intervene on behalf of union leaders, asking that a settlement be arrived at by conciliatory means. On Dec. 22 representatives of municipalities in the Kirkland Lake and Porcupine camps met Labor Minister Mitchell, who succeeds Norman McLarty, and urged that immediate action be taken to settle the strike. Reeve R. J. Carter of Teck Township said, "Apart from the anxiety over loss of revenues, I must say that I am impressed with the quiet way in which the strike has been conducted. We are very hopeful Mr. Mitchell will find a way out and bring an end to the strike. We placed our position before him in full." Attorney-General Conant of Ontario refused to rescind the bylaw that establishes a police commission in Teck Township. The Kirkland Lake strike has demonstrated the need for such a commission, he said, and shows the need for police protection removed from local politics and disputes.

▶Jason Mines has produced bullion valued at $1.096.380 from the time milling was started in June, 1940, to the end of November, 1941. The mill is treating an average of 135 tons daily, with an average recovery of $16.36 a

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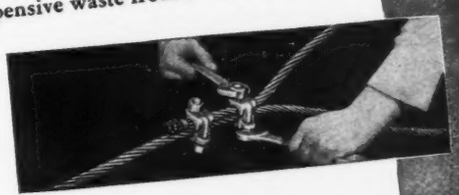

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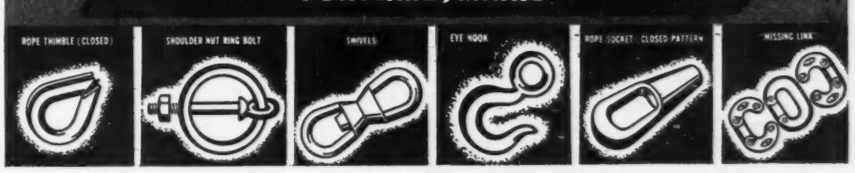

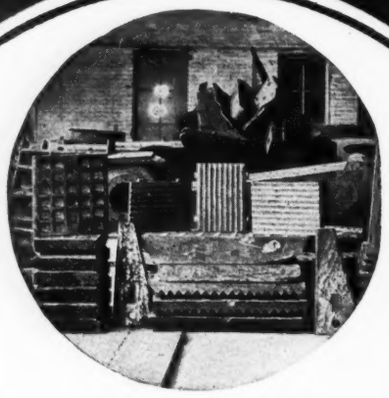

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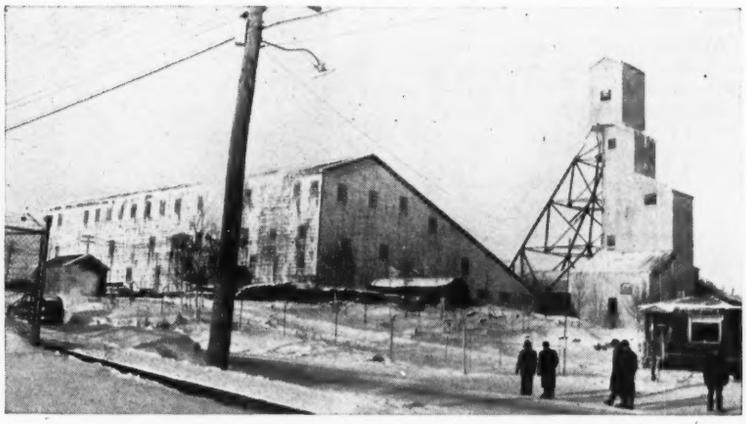


Four strikers on picket duty and officers of the Ontario Provincial Police at entrance to plant of Kirkland Lake Gold Mining Co., Ltd., where full production of 400 tons a day was started on Dec. 3, beginning the third week of the CIO strike

▶CANADA

ton. Operating costs, before write-offs, are $9.59 a ton. E. M. Thomson is president.

▶McMarmac Red Lake Gold Mines, in the Patricia district of northwestern Ontario, has deepened the shaft 300 ft. to a total depth of 750 ft., and a new hoist has been installed. The new fourth and fifth levels are running crosscuts out to the carbonate zones, where ore has been developed at shallower horizons. Since milling was started in November, 1940, the mine has produced $523,947, recovery averaging $18.40. The president, W. G. Armstrong, reports an estimated operating profit for the last six months of $135,049.

▶At the annual meeting of MacLeod Cockshutt Gold Mines, the vice president, Joseph Errington, told shareholders that the mine has been built from a small mine to a big mine as a result of extensive development. Starting with a 300-ton mill for the treatment of ore from the south zone, exploration had been carried to a depth of only 300 ft. when the discovery of the north ore zone led to concentrated efforts in that area. The company had acted on the request of the Canadian Government in enlarging the mill to 1,000 tons' capacity, with provision for a further increase to 1,500 tons later. Delays in delivery make it uncertain when the new equipment will be ready to use.

QUEBEC

▶Early in December material began arriving at the property of Quebec Manitou Mines, 4 miles east of Val D'Or, for the construction of a 600-ton zinc concentrator. The Canadian Comstock Co. has the mill contract, which is expected to be completed by May 1. The property has been taken over by a new company, Golden Manitou Mines, and financing is being done by means of an $850,000 bond issue that has been firmly underwritten by two Toronto brokerage firms. An ore estimate by C. H. Poirier, consulting engineer, shows 500,000 tons of positive ore to a depth of 375 ft. and an additional 1,000,000 tons to the 650-ft. horizon. The positive ore has an average content of 0.10 oz. gold, 4.63 oz. silver and 10 percent zinc, which would be valued at $9.32 a ton according to the contract given the company for the sale of zinc concentrates over the next two years. Operating costs are estimated at $4 a ton. Senator W. H. Sharpe, president of Quebec Manitou, is also president of the new company. Andrew Robertson is mine manager and the General Engineering Co. is the consultant.

BRITISH COLUMBIA

▶Consolidated Mining & Smelting Co. is to build a plant to recover magnesium from magnesite to come from the Marysville mine, near Kimberley, in the East Kootenay district, where a large deposit of crystalline magnesite is known to exist. Although the plan location has not yet been divulged, it is expected that it will be in the West Kootenay district, near Trail, where an abundant supply of electric power is available. Construction is being undertaken at the instigation of the British Government and is expected to require about ten months. Initial capacity will be 15 tons daily.

▶Recent rise in the zinc price has had favorable effect upon activities of Base Metals Mining Corp., Ltd., operating the Monarch and Kicking Horse mines in the Golden mining division. It has permitted mining a proportion of lower-grade ore, which will materially extend the operation's life. Current development has disclosed new ore in a section hitherto unexplored.

▶Sheep Creek Gold Mines, Ltd., is paying a bonus of a cent per share with the regular quarterly dividend of 4c. Total production for the first half of the fiscal year (ended Nov. 30) was valued at $523,256 compared with $491,288 for the corresponding period of the previous year. Increase in average grade from $17.83 to $19.12 accounted for the increase in output value. The Alexandra vein has been cut after crosscutting for 2,060 ft. from the "92" vein on the seventh level.

▶ Gold Belt Mining Co. produced 1,661 oz. gold, valued at $58,150, from 4,853 tons in November.

▶ Bayonne Consolidated has declared an initial dividend of a cent per share, involving $25,000. Both reserves and finances have shown steady improvement. New bodies of good ore have been found on the extension of the eighth, or bottom, level further into the mountain. Diamond drilling indicates that these persist to at least 100 ft. below the present bottom, where assays of 1.24 oz. gold have been obtained over a 1.4-ft. width. An average of $26,000 was recovered monthly during 1941. Grull-Wihksne Gold Mines, Ltd., holds an interest of slightly less than half.

▶ Relief-Arlington shareholders have ratified the directors' decision to liquidate and have approved the appointment of D. G. Marshall, of 626 Pender St., West, Vancouver, as liquidator. A further distribution is likely but will depend upon the amount realized through disposal of plant, equipment, and the Second Relief mine. The company also owns the Arlington mine, now leased to R. O. Oscarson, who has conducted a small, successful operation over a long period. He has been notified that the lease will terminate as of July 31, 1942, when the property will be offered for sale. From Jan. 1, 1941, up to July 12, the company mined 27,145 tons and milled 14,404, producing 5,305 oz. gold and 1,900 oz. silver. Premier Gold holds 1,530,000 of the 3,000,000 shares of Relief-Arlington.

▶ Cariboo Gold Quartz has paid its regular quarterly dividend of 4c. per share, with an extra dividend of only 1c. This makes a total of 23c. per share for the year, compared with 24c. last year. Increased operating costs and heavy outlay for exploration and development of the B.C. vein, which so far has yielded no appreciable tonnage, are held responsible for the dividend reduction, as the value of output in the first nine months was $1,419,650, compared with $1,190,844 in the same period of the previous year.

▶ During November, Island Mountain Mines Co., Ltd., recovered 2,061 oz. gold from 4,334 tons of ore milled.

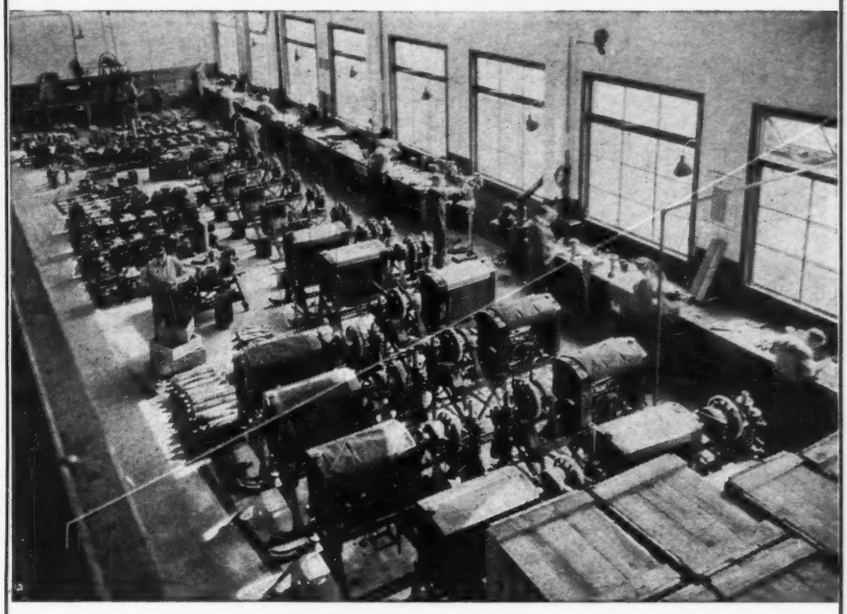
▶ The 1941 clean-up of the Lowhee Mining Co., Ltd., largest hydraulic operation in the Barkerville area of the Cariboo, has been approximately 1,700 oz. gold, somewhat less than that of the previous year. Boulders, deep pockets, and sliding ground hampered operations. The monitors should reach the present overnight reservoir by next July and from then on water storage will be much reduced.

▶ Colin Campbell, of London, England, previously reported as representing the British Government in an examination of the property of Consolidated Nicola Goldfields, Ltd., was, it has since been ascertained, actually acting on behalf of British interests and not for the government.

▶ The Ketch hydraulic operation has recovered about 800 oz. of gold this season from benches paralleling Slough Creek, near Wells.

▶ Central Zeballos' new ninth level crosscut has reached what is thought to be the downward continuation of the main, or "Bibb," vein, after driving 2,285 ft. Un-

FOR EXPORT



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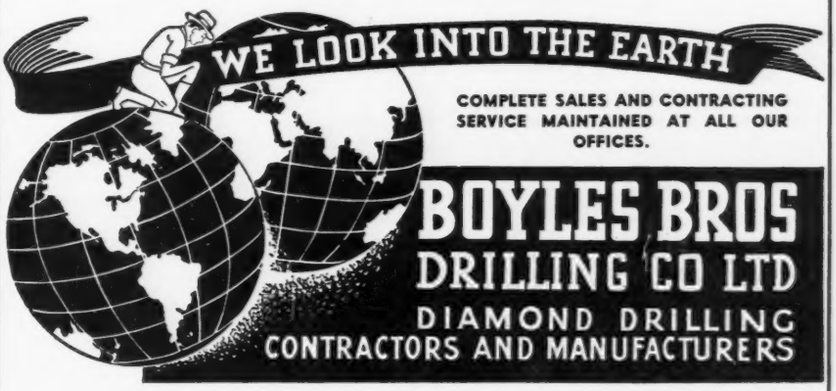
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SAUERMAN Machines are backed by over 30 years of specialized experience in designing this type of equipment. We give you an expertly engineered unit, designed and built to meet your exact requirements. Whether it is a machine to handle 10 tons per hour or many thousand tons per day it will be simple and economical and easily operated by one man.

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(KOPPEL DIVISION)
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▶ CANADA

dertaken to eliminate raising, pumping, and tramming, it was driven on a horizon, 700 ft. below the upper-adit level and 400 ft. below the bottom of the winze from the fourth level. A raise will now be driven to connect with upper development.

▶ November production of Spud Valley Gold Mines, Ltd., was valued at $42,708, from 3,437 tons, averaging $12.43 per ton, compared with $39,761, from 3,696 tons, averaging $10.76, in October.

▶ During November, Privateer Mine, Ltd., produced 2,165 oz. gold, valued at $75,788 ($35 per ounce), from 2,612 tons, averaging 0.829 oz. gold per ton.

YUKON

▶ Dredging operations for the 1941 season ended Nov. 29, when Yukon Consolidated Gold Corp. shut down its last dredge on Middle Klondike River. November recovery was valued at approximately $124,000, compared with $327,000 in October. The year's recovery is of less value than that of preceding years, due largely to the strike in July and August.

▶ Property and equipment of Holbrook Dredging Co., in the Sixtymile River area, have been taken over by Idaho-Canadian Dredging Co., which is now building a large dredge on Big Gold Creek.

AFRICA

Higher Gold Output in Kenya and Tanganyika

Principal producer is Geita gold mine—Promising tin deposit in Belgian Congo being developed

▶ In view of the many disappointments sustained by those undertaking to develop gold mines in Kenya Colony and Tanganyika Territory, it is pleasing to learn that the gold output of both showed a satisfactory increase the past year. The Tanganyika Territory increase seems to have been due almost wholly to the large and growing production of the Geita gold mine, controlled by Tanganyika Consolidated Copper interests.

▶ Consolidated Main Reef mines set up new high records of tonnage milled and gross revenue last year, but the increased profit of 3d. per ton was slightly more than offset by increases of 1s. in operating costs and of £57,300 in taxes. Its final net was £804,300, against £811,200. Ore reserves at 10,600,000 tons show a small reduction, but a more abundant native labor supply encourages the expectation that reserves will increase again in 1941. The dividends were reduced from 30 percent to 27½ percent.

▶ Although the miners of tin are enjoying great prosperity—Tronoh Mines is paying 55 percent this year against 22½ percent last—the outlook for tin is

causing much concern. Canned foods have greatly increased the demand for the metal and likely will continue to grow, and only two at all important sources of tin production have been discovered in recent years. One of these, the Belgian Congo deposits, may become a large source of production. The other, in Thaïland (Siam) now virtually controlled by Japan is the development of a larger and richer deposit in an old district. It is claimed that several of Malaya's alluvial deposits are nearing exhaustion.

▶ Mufulira Copper is declaring no dividend this year. The reason is that the company is severely penalized by the hastily constructed war tax enactment. In the years taken as the standard, above which practically all profit goes to the government, Mufulira was in the construction stage and only beginning to produce. The consequence is that its now splendid net earnings are practically all paid in taxes and nothing is left for interest on the vast capital outlay which was required to bring it to production. It is the accepted view, however, that the inequity of this will be corrected when political conditions return to normal. Some engineers and geologists believe that Mufulira will in time become the greatest of the Northern Rhodesia copper mines. When the trend of its orebody is tied up with an outcrop many miles distant it may be assumed that if the ore persists only half the intervening distance the total of the resources will be approximately a billion tons, and the average grade is likely to be rather better than 3 percent.

▶ The small decrease in the Witwatersrand district's gold production in September seems likely to have been more than made up for in October, as nine-tenths of the mines making returns up to this writing show appreciable increases of output. Western Reefs, the new producer, almost doubled its September total, and East Daggafontein and East Champ d'Or made new high records.

▶ Blyvooruitzicht Gold Mining is continuing to provide sensations. The latest official report states that 1,045 ft. of openings on the Carbon Leader have now been sampled and the average value of the whole found to be 69.5 dwt. over widths averaging 14.6 in. The work of opening up the property is being speeded. Its possibilities are measured by the fact that the enormous profits of the Witwatersrand mines are won from ores averaging less than 5 dwt. per ton. Estimates are being made that with its pilot plant of 8,000 tons' monthly capacity Blyvoors will make a profit of £500,000 to £1,000,000 a year.

▶ Further information has been released as to the values obtained by the African & European Investment Co. by borings in the Orange Free State, some 50 miles southwest, from the Blyvooruitzicht property. Where cut by diamond drills the Leader Reef showed an average of only 1.2 dwt., but three penetrations of what has been named the Basal Reef (one by deflection) showed an average of 111.0 dwt. per ton over a width of only 6 in. These values were found at a depth of just over 3,500 ft.

▶ It is interesting to note that while some African gold mines' costs increased during the past year, those of

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ATLAS TYPE "K" STORAGE BATTERY LOCOMOTIVES

Here's haulage efficiency that answers the need for a storage battery locomotive between the 1½ ton and 3 ton types . . . the ATLAS 2½ ton type "K". It embodies all the engineering and design experience acquired in 45 years of building metal mine haulage equipment. Anti-friction bearings throughout . . . spur gear drive . . . are a few of the features that mark the ATLAS type "K" battery locomotive. With your operations at a maximum, the type "K" can be of great value to you. Write, and we'll forward details on this and other ATLAS storage battery locomotives and haulage equipment.

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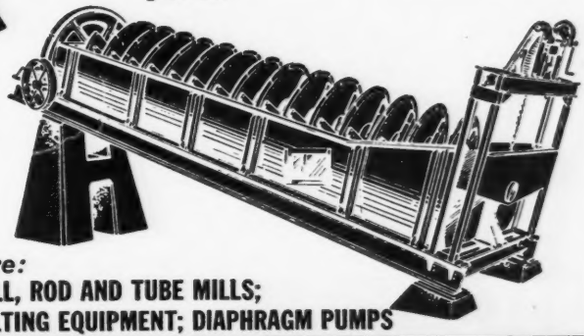

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▶AFRICA

others were reduced. Cam & Motor, whose earnings were almost exactly the same as the year before (£296,190 against £296,300), had a lower operating cost, and ore reserves were increased by 8,700 tons to 1,731,500 tons averaging 7.4 dwt. per ton.

▶ Tanganyika Consolidated has paid the regular dividend of 4 percent on its £2,305,783 of preference shares for the year ended July 31 last. This indicates that it is receiving dividends regularly on its large holdings of Union Minière du Haut-Katanga shares.

▶ Diamond mining, though producing a luxury which would have been expected to be among the first to be affected adversely by the war, is enjoying a good measure of prosperity. Some of the equipment and cutters having been brought over from Holland when Germans invaded that country, a diamond-cutting business was established in Britain, and this has made notable progress. From a small beginning it has grown to an output now at the rate of approximately £1,000,000 a year. At the recent sale of "sights" in London over £500,000 worth of diamonds were sold. Prices were firm but unchanged, and there were many foreign buyers. A shipment of Brazilian diamonds has brought 10 percent higher prices than the last previous shipment. This was possibly due to industrial diamonds being included. The demand for industrial diamonds seems to have cleaned up all existing stocks, and now largely exceeds the supply, Russia having been a considerable buyer. This demand must be making a great difference to the producers, as only a few years ago they were endeavoring to extend the industrial use of diamonds and so increase their sale.

A.I.M.E. CONVENES IN NEW YORK, FEB. 9-12

THE ANNUAL meeting of the American Institute of Mining and Metallurgical Engineers will be held in New York City, Feb. 9-12. Problems of the mining industry, now involved in an all-out effort to win the war, will be the important theme of this year's meeting.

IT IS AGAIN PLANNED to have the "All Institute" luncheon at the Commodore Hotel Feb. 9th. A speaker prominent in the Washington scene is expected to address the meeting at this time. The annual banquet and reception will be held Feb. 11 at the Waldorf-Astoria Hotel, at which time the Institute's new president, Eugene McAuliffe, president of the Union Pacific Coal Co., will be introduced.

The Merrick Weightometer provides a continuous, automatic, accurate weight record while material is in motion on conveyor. It weighs without interrupting conveyor service.

Applicable to any size belt conveyor, horizontal or inclined. An accurate and dependable means of keeping constant check on production.

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EQUIPMENT NEWS

PRODUCTION REQUIREMENTS PLAN SET FOR MANUFACTURERS

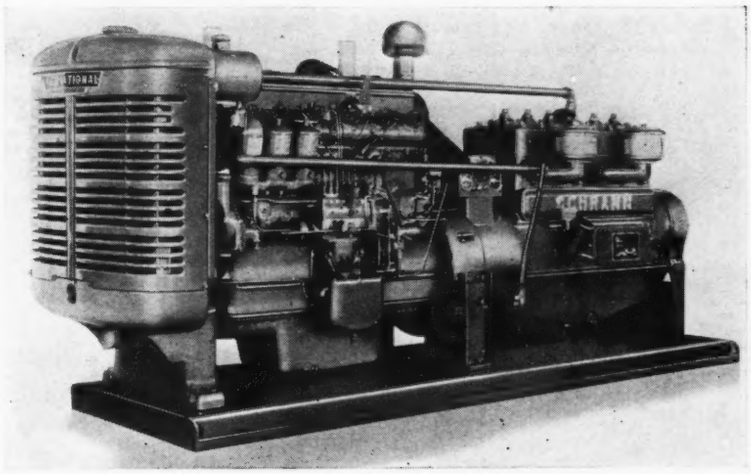
MINING machinery manufacturers have been given the benefit of a new preference rating order P-56-a, replacing P-23, which expired Dec. 31, 1941. The new order is intended greatly to facilitate the acquisition by manufacturers of scarce materials required in making mining machinery. Its further value lies in the provision for rating-approved deliveries for an entire calendar quarter.

A schedule of machinery which comes under the new order covers mine supplies, from aerial tramway equipment to wire rope, and includes all common forms of equipment. Complete details can be obtained in a copy of the order issued by the Priorities Division, OPM, Washington, D. C.

Basically, the new order permits mining machinery producers to obtain the A-3 rating applied to machinery in P-56 (see *E.&M.J.* Dec. '41, page 97) as well as opportunity to order supplies in advance for specific production as outlined under the Production Requirements Plan. Manufacturers using the P-53-a procedure, file Forms PD-25-A with the Mining Priorities Division, under Dr. Wilbur Nelson, Administrator, Mine Priorities, OPM, Washington, D. C.

Mining companies continue to use the procedure set forth in Order P-56 as outlined on these pages last month. Only through citing orders for new equipment from mining operators may manufacturers be able to obtain the priority aid of P-56-a.

Compressor



ANOTHER ADDITION to its comprehensive line of compressors by Schramm, Inc., West Chester, Pa. is the new Engine Drive-in Line compressor. Built in sizes ranging from 120 to 600 cu. ft. displacement, these outfits are made available for those applications not reached by electric power service or where gasoline, oil, distillate, or diesel power units are preferred as a driving medium. A number of standard assemblies have been provided in semi-portable and stationary types. Mounted on a sturdy deck type base ready for immediate operation, these light, compact, easy-to-handle combinations are used with equal success for semi-permanent service on contracting or tunnel work, prospecting, mining, industrial use on short time, overtime, or night work where the demand for air is such that it is not economical to operate large compressors.

For installation in isolated or arid locations where running water is not available, all of the advantages of water-cooling are reported to be retained by using the manufacturer's radiator water cooling.

New Process For Synthetic Pine Oil

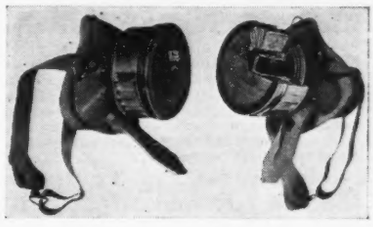
A PROCESS for the synthetic production of pine oil from gum turpentine which makes it possible for the naval-stores industry to meet current demands of the national defense program for this material is announced by Hercules Powder Co., Wilmington, Del. The process developed by the company produces synthetic pine oil of substantially the same chemical and physical properties as natural pine oil. It may be described chemically as a well-defined mixture of terpenes and secondary and tertiary alcohols having a mild aromatic pine aroma.

Pine oil is now required in great quantities for the separation of metals from their ores. Defense demands for zinc, lead, copper, and molybdenum have greatly increased consumption, and laboratory and plant tests indicate this new pine oil suitable as a flotation reagent.

"The major influence on the price of the new oil will be the price of gum turpentine," the company reports. "Because of current relatively high prices for gum turpentine, the price of the new oil will be considerably higher than that of natural pine oil. The new process, however, will assure an increased supply of pine oil for defense industries and possibly make available some supplies for non-defense uses."

New Respirator

A RESPIRATOR reported to afford maximum protection against the inhalation of pneumoconiosis-producing and nuisance dusts was announced recently by the DeVilbis Co., Toledo, Ohio. Approved by the U. S. Bureau of Mines, the new "M S D" respirator is said to embody nine unique features. These combined, are said to make it more compact, lighter, easier to breathe through, more



comfortable to wear, and easier to clean and maintain than previous models.

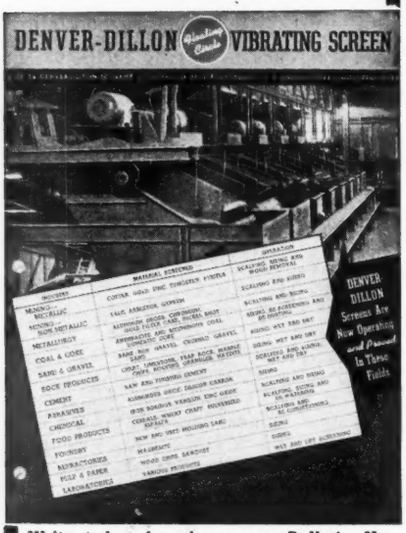
The new respirator measures only 2¾x ½ in., weighs but one ounce, and provides more than 41 sq.in. of breathing and filtering area. Multi-vane construction allows every inch of this filter to be used efficiently. This means no air restriction to cause difficulty in breathing, plus greatly increased filtering efficiency. The filter is easily cleaned by blowing accumulated dust from vanes with an air dusting gun or nozzle, thus maintaining peak performance and requiring less frequent replacement.

Ball Grip Couplings For Plain End Pipe

A BALL GRIP coupling fully tested for high pressures as well as vacuum, permitting flexibility at the joint and simplicity in making connection or disconnecting, has recently been introduced by Hanlon-Waters, Inc., Tulsa, Okla. Many features are outlined by the manufacturer for its couplings, assuring faster installation with resulting savings for either permanent or temporary pipe lines. Provision is said to have been made for expansion, contraction, and angular deflection of 7 deg. each end of coupling.

The H-W ball-grip couplings consist of a housing with ball retainer and a flexible sealing gasket. The ball retainer or cage carries a plurality of balls and a frictionally engaging means, so that after the pipe is inserted and pulled outward the balls are brought into contact with the tapered surface, causing a positive lock, preventing the pipe from being withdrawn. One bolt tightens connection and the same bolt reversed automatically allows coupling to be dismantled. No

A NEW BULLETIN YOU WILL WANT



Write today for above new Bulletin No. S3-B3, Denver-Dillon Vibrating Screens have been proved by over four years of service in numerous industries. Operators report definite reduction in screening costs. "Floating Circle" principle requires less than half of the average power of other means of screening.

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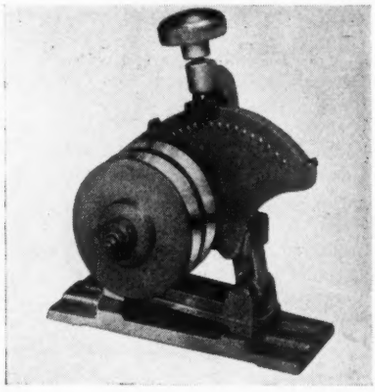
special tools are required—a small-size wrench is all that is necessary to take coupling off the pipe, apply tension, and at the same time rotate the coupling. All couplings are provided with a pipe stop to assure pipe being centered in coupling. The coupling further permits rotating of valves and fittings on pipe axis without disconnecting.

The manufacturer states the couplings will provide safety to miners in cases where mines cave in, by enabling the miners trapped to help themselves get air, water, and food. This is made possible through use of the coupling: the piping system could be easily disconnected at any coupling, making it then possible to pump air, water, and food in special containers through the pipe line, to the trapped miners.

Variable Speed Control For V-Belt Drive

A V-BELT variable-speed transmission known as the JFS-Cub is being introduced by the Standard Transmission Equipment Co., of 416 W. 8th St., Los Angeles, Calif.

The V-belt speed controls are especially designed for all "A" section V-belt applications and for speed ranges up to 3.3–1. Smooth-sided pulleys are used rather than the interlocking type. Among the advantages claimed are: the patented positive belt alignment feature

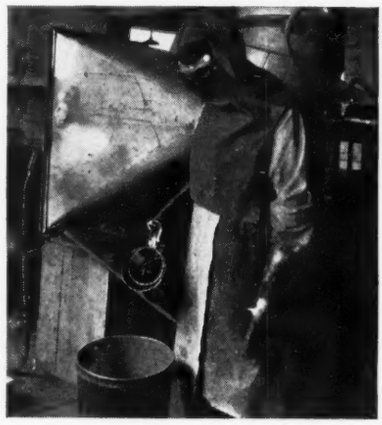


which makes possible the mounting of the unit in any and every position without impairing function or throwing belts out of alignment; machined and balanced cast iron construction, forced lubrication of the special bronze bearings on which the pulleys rotate; free-end pulley spindle to permit easy installation of belts; both pulleys on one side of pivotal mechanism, which permits motor pulley and driven pulley to be almost directly in line with each other.

Flow Alarm

THE FRED H. SCHAUB ENGINEERING CO., 325 West Huron St., Chicago, Ill., announces a new flow alarm designed for high- or low-pressure service on water, oil, gas, or air line applications when a signal is needed to indicate starting, stopping, or insufficient flow. Magnetic operating principle eliminates the use of all stuffing boxes, bellows, diaphragms, or rotary shafts to gain switching action. This is said to assure positive operation, as there is nothing to stick, bind, break, or clog up. Installation can be made where an ordinary check valve will operate.

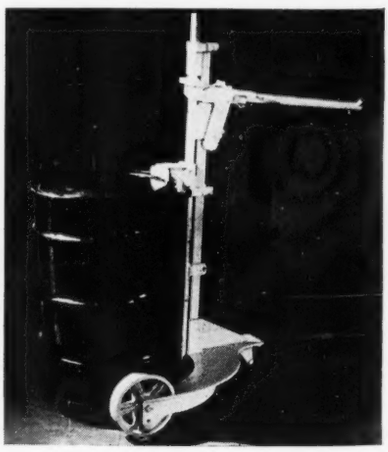
The Magnetrol flow alarm consists of a full-ported globe valve body to which is attached the patented magnetic switching arrangement. The switch head and valve piston assembly are attached to the valve body by a union bonnet nut, which makes removal for inspection a simple operation. Units are available in a complete range of standard pipe sizes up to 4 in. and the standard equipment mercury-to-mercury electrical switch is rated at 15 amps., 125 volts, 10 amps., 250 volts.



Complete head and neck protection for workers handling acid and other dangerous solutions is provided by the Bullard Acid Mask, made by E. D. Bullard Co., 275 Eight Street, San Francisco, Calif. The shatter-proof laminated goggles fit snugly around the eye cavities so that the hood cannot slip or turn. This feature assures good vision when the head is turned in any position

Carrier For Heavy Drums

A MODEL CARRIER designed and constructed for handling drums used as containers of heavy materials is announced by Ernst Magic Carrier Sales Co., 1456 Jefferson Ave., Buffalo, N. Y. Built into this new model are features that produce labor saving advantages. One man using only one hand with this carrier can break-over, balance, and



move heavy drums. In addition, all accidents common to handling loaded containers are said to be prevented by the simple lifting device and self-balancing tri-wheel design. Copper-silicon alloy metal wheels and locking device are available where precaution against explosions is necessary. This new model has a capacity up to 600 lb.

Mine Telephone Cable

A MINE TELEPHONE CABLE with the mechanical and electrical strength of large cables but a diameter of slightly over ¼ in. has been announced by the General Electric Co., Schenectady, N. Y. This twisted-pair, No. 14 Awg solid cable is designed for mine telephone service where induced currents and cross talk must be reduced to the minimum.

Versatol insulation makes the cable heat- and moisture-resistant. A tellurium-compounded rubber jacket insures protection against mine waters and soil acids. Breakage is reduced by use of hard-drawn tinned-copper conductors, with one conductor ribbed for easy identification.

The new cable can be run through water without ill effects, can be hung on pegs, or buried in the ground. Its light weight (80 lb. per 1,000 ft.) makes it easy to transport to any desired location.

First-Aid Kit

A COMPLETELY WEATHERPROOF first-aid kit, known as the Bullard Weatherproof, is announced by the E. D. Bullard Co., 235 Eighth St., San Francisco, Calif. The kit has a mounting bracket that permits it to be removed instantly and carried to the injured. It mounts to the wall or post in such a way that when the lid is opened it acts as a shelf for the treatments being used.

Contents are protected from the weather by a special "weather-strip" rubber tube that also acts as a spring that opens the lid when the fastener is released. Contents are easily removed whether the kit is laying flat or wall mounted, because the sides are lower than the individual packets of treatments, which furnishes plenty of finger room.

BULLETINS

High Voltage Starters. General Electric Co., Schenectady, N. Y. GEA-3630 describes the design, construction, and application of the manufacturer's new 2300-v. contactor motor starter, which can be safely applied to high-capacity power circuits. Pp. 12.

Radium Detector. Geophysical Instrument Co., Washington, D. C. Circular E describes the company's Geiger Counter Type Radium Detector for discovery of lost radium or prospecting for radio-active materials. Pp. 4.

Angle Meter. Interstate Sales Co., 1123 Broadway, New York City. Leaflet describes the company's slide rule for laying out of angles directly on pipe or sheet metal. Pp. 4.

Welding Products. American Manganese Steel Division, 389 E. 14th St., Chicago Heights, Ill. Bulletin 941-W describes the company's line of welding products for reclamation, hard-surfacing, and repairing of various equipment parts. Pp. 12.

Draft Gage. Hays Corp., Michigan City, Ind. Publication 41-472 describes air draft under the headings of what it is, where found, how measured, and why important in modern industry. Pp. 20.

V-Belts. Thermoid Co., Trenton, N. J. Bulletin 3726 describes the company's complete line of V-belt drives for multiple and fractional horsepower. The book is thumb-indexed and has engineering information on V-belt drives. Pp. 79.

Water Stoppage. American Colloid Co., 363 W. Superior St., Chicago, Ill. Bulletin 229 describes Volclay, a natural hydrous silicate of alumina or a special kind of bentonite clay that has the ability to absorb many times its own weight of water and to swell enormously in the process. The increase at full saturation ranges up to 15 times its dry bulk. It is used for stopping water losses occurring in ponds, lakes, dams, concrete pools, building foundations, cracks, mines, and bulkheads. Pp. 12.

Steel Grating for Floors. Open Steel Flooring Institute, Inc., American Bank Building, Pittsburgh, Pa. File 14P21 is a bulletin describing open steel floor grating for use in mills and other industrial buildings. Pp. 12.

Colorometric Analysis. Fisher Scientific Co., Pittsburgh, Pa. Folder describes the company's new a.c. instrument, known as the electrophotometer for color analysis. Pp. 8.

Woven-Wire Screen Cloth. Robins Conveying Belt Co., Passaic, N. J. Bulletin 113 describes and illustrates the manufacturer's line of woven-wire screen cloth for various industrial uses. Pp. 7.

"How to Get Steel at the Present Time" is the title of a small booklet issued by the Colorado Fuel & Iron Corp., Denver, Colo. The booklet contains specifications for grinding balls and rods and various types of rails.

Steam Cleaners. Homestead Valve Mfg. Co., Coraopolis, Pa. Catalog 17A-10 describes uses of the manufacturer's Jenny steam cleaners for use in the various industrial fields.

Lathes. South Bend Lathe Works, South Bend, Ind. Bulletin 52 describes the company's entire line of precision lathes. Pp. 8.

Electronic Control System. General Electric Co., Schenectady, N. Y. Publication GED-972-A describes the company's Thy-mo-trol, a new electronic control system for the operation of d.c. motors from a.c. motor lines. Pp. 8.

Ball Mill Liners. American Manganese Steel Division, Chicago Heights, Ill. Bulletin 1141-L discusses the question of the most suitable metal for ball-mill liners. Pp. 7.

Wrenches. Blackhawk Manufacturing Co., Milwaukee, Wis. The company has issued a "Handy Guide," a pictorial bulletin to serve the buyers and users of wrenches. Pp. 49.

Variable Speed Transmission. Standard Transmission Equipment Co., 416 West 8th St., Los Angeles, Calif. Folder describes the manufacturer's small, variable speed transmission adapted to machines driven by "A" section V-belts. Pp. 1.

Chimney Cements. Republic Flue Cement Co., Talcott Ave. and Second St., St. Louis, Mo. Bulletin describes and illustrates uses of the manufacturer's flue cements for smelter stocks and concrete, brick, and metal stacks for use inside and outside. Pp. 6.

Respirator. The DeVilbiss Co., Toledo, Ohio. Form F-223-35M describes and illustrates the company's new lightweight dust respirator. Pp. 4.

Scrapers. LaPlant-Choate Mfg. Co., Inc., Cedar Rapids, Iowa. Bulletin describes the manufacturer's combination scraper and loading unit, consisting of the Caterpillar Diesel DW-10 Tractor and LaPlant-Choate CW-10 Carrymore Scraper. Pp. 16.

Welding Procedures. Air Reduction Sales Co., New York, N. Y. Bulletin 4ADE846 is a comprehensive loose-leaf booklet describing various methods of welding practice. Welding of aluminum, copper and copper alloys, gray cast iron, hard-facing, steel, wrought iron and gas welding rod consumption data are included. Price 60c. Pp. 54.

Industrial Control Devices. Minneapolis-Honeywell Regulator Co., a division of the Brown Instrument Co., Philadel-

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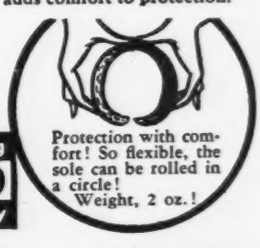

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phia, Pa. Catalog 8301 is a comprehensive source of information for all interested in automatic control of industrial processes. Temperature controllers, pressure controllers, humidity controllers, float switches, combustion safeguards are described and illustrated. Pp. 56.

Compressed Air Institute Announces Prize Contest

THE Compressed Air Institute announces a nation-wide contest for industry, closing June 1, 1942. Fourteen cash awards will be given. These comprise a first prize of $100; three $50 prizes and ten of $25, and as many additional awards of $25 as there shall be contestants who submit material acceptable for use in technical journals. Virtually no restrictions are placed upon the eligibility of contestants. Nor is the subject matter of their presentations limited other than it be concerned with some use or phase of compressed air. The contest is open to any employee of any organization using or associated with compressed air in any department. The only exceptions are executives of companies comprising the Institute.

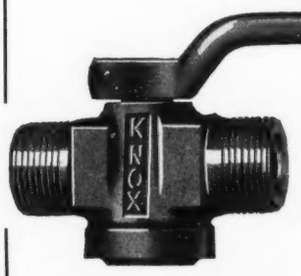
Articles submitted are to be judged according to the usefulness to the industry of the idea submitted; the originality of the text; the value of the text to the greatest number of industries; and the technical accuracy and completeness with which the subject is treated. Subject matter may deal with anything of particular interest to the compressed air industry.

Members of the Institute's Educational Committee, under the supervision of which committee the contest is being held, include: Chairman, H. H. Miller, of Worthington Pump & Machinery Corp.; H. P. Bailey, of the Rotor Tool Co.; J. W. Haddock, of Sullivan Machinery Co.; M. L. McCormack, of Ingersoll-Rand Co.; P. F. Stauffer, of Fuller Co.; T. P. Harris, of Chicago Pneumatic Tool Co.; and J. S. Tatman, of Roots-Connersville Blower Corp. They request that all contest presentations be mailed to C. C. Rohrbach, Secretary, Compressed Air Institute, 90 West St., New York. Executives of any concern using compressed air are invited to apply for free contest posters for shop and office bulletin board display. They are available on request to the Institute's Educational Director, Russell Gross, East Orange, N. J.

INDUSTRIAL NOTES

C. E. Herington has been appointed sales director of a newly created sales service department established by the **Meehanite Research Institute of America, Inc.,** Pittsburgh, Pa. The object of the department will be to provide assistance in the solution of current and future selling problems encountered by Meehanite manufacturers in the United States and Canada.

The name of the International Agricultural Corp. was changed to **International Minerals & Chemical Corp.,** effective Dec. 1. The company mines phosphate in Florida and Tennessee, and potash in New Mexico.



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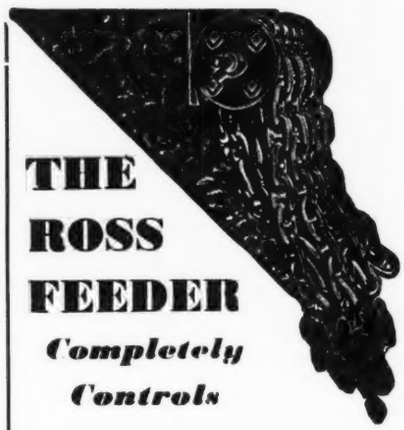

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Softening Water With Non-Metallic Minerals—III

Aluminum Compounds; Sodium Aluminate—Aluminum compounds, especially sodium aluminate, when used with the lime-soda process are of material aid in increasing the removal of hardness. It is believed that aluminate ion reacts with the soluble magnesium salts in the water to form an insoluble magnesium aluminate. A distinct advantage of sodium aluminate is the rapid reaction in the cold, forming a flocculent precipitate, which in muddy waters serves to replace alum as a coagulant and at the same time acts as a water softener. Many instances can be cited in which the effluent was noticeably lowered in hardness by the use of sodium aluminate. For instance, a straight lime-soda softening reduced a hard water from 17.4 grains per gallon to 3.7 grains per gallon. The addition of sodium aluminate further reduced the lower figure to 2.3. One grain per U.S. gallon is equivalent to slightly over 17 parts per million. As total remaining solids are calculated as scale-forming constituents in boiler-feed water, a scale-removing cost charge is placed against each percentage of remaining total dissolved solids. Consequently, any compound or method reducing the hardness of the treated water is an asset. One may cite much experimental evidence to prove the beneficial effect of the addition of sodium aluminate to a lime-soda softening.

Barium salts (hydrate and carbonate) are preferable to sodium salts for the removal of noncarbonate hardness. The barium sulphate formed is highly insoluble, and hence the non-carbonate hardness, soluble salts of SO_4, is removed, whereas with lime and soda ash the sodium sulphate formed is soluble and concentrates in the boiler. Barium salts are used in most plants in conjunction with lime. Owing to their high cost, however, they are used only when a high concentration of $CaSO_4$ and resulting Na_2SO_4 necessitates removal of the sulphate.

Phosphate; Sodium Hexametaphosphate ($NaPO_3)_6$— Phosphate rock, a non-metallic mineral indispensable to agriculture, is also the raw material for a wide range of complex phosphate compounds. These compounds are perhaps more intriguing and their chemical reactions in water less understood than any other series of compounds in the realm of inorganic chemistry. The most important of the phosphate compounds in the field of water purification is sodium hexametaphosphate, used principally for conditioning boiler water, as a cleansing agent for dairy equipment, cleaner for household utensils, and as an indispensable agent in the textile industry. The Hall Laboratories, at Pittsburgh, Pa., have developed a series of trademarked products with sodium hexametaphosphate as a base. "Calgon" (from "calcium gone") is perhaps the most commonly known of these products. Other uses of the phosphate compounds are rather diversified, but as their applications are not in the field of water purification they will not be discussed here further.

Sodium hexametaphosphate is used in water treatment because of its peculiar ability to function as a water-softening agent. As little as 1 or 2 p.p.m. added to a hard water inhibits the usual precipitation of calcium carbonate. It is also used extensively as a corrosion inhibitor, greatly reducing or even eliminating the tendency of metal objects to corrode in certain waters. The many other unusual properties of sodium hexametaphosphate are described by Hatch and Rice.

Seminatural Zeolites — 1. Treated Glauconite or Greensand—The correct name for this zeolite is glauconite (from the Greek word "glaukos," meaning bluish-green), but, owing to its granular appearance and greenish color, it has taken on the appropriate descriptive name of greensand. Glauconite is a definite mineral, being a hydrous silicate of iron, alumina, and potash. More definitely it consists of one-half silica, one-fourth iron oxide, one-tenth alumina and magnesia, and one-sixth potash, water and other substances, the potash being 1 part in 13. The other substances are calcium and sodium and traces of the rarer elements. Samples from different localities may vary widely in analysis, but the potash content is fairly uniform, averaging 7 to 8 percent. The potash analysis is often used as a basis for rough estimation of glauconite in a greensand. The term "greensand," as commonly used, also applies to a sandy deposit containing glauconite, quartz, and 50 percent of inert material.

Greensand is widely distributed in the United States, large deposits being found in New Jersey, Delaware, Maryland, Virginia, North Carolina, Tennessee, Texas, Arkansas, and recently in Alabama.

The use of greensand as a water softener in 1922 brought about a revival in the industry, for in that year four operators reported 8,775 tons, valued at $56,800, equivalent to $7 a ton. The following year the price rose to $12. The high price of the material is in sharp contrast to the $1 per ton value placed on the crude material used as a fertilizer. In 1926, 12,761 tons, valued at $224,871, was mined in New Jersey alone. Demand for water softening still continues, but the development of improved synthetic zeolites of high capacity has tended to offset the use of greensand.

As it occurs naturally the mineral is composed of granules from 0.1 in. in diameter down to colloidal dimensions. The fine claylike material binds the whole together. When cut with a shovel, however, the mass crumbles and falls apart. Processing greensand for a water softener is simple. The overburden is stripped off with steam shovels, but the actual mining is performed by hand, as this allows hand-picking of the richer material and rejection of the undesirable part. The raw greensand is transported to the plant, where it is given a cold-water wash, which separates about 1 percent of coarse rejects. Further washing is done in Dorr classifiers to separate and discard the bulk of the fines. Only granules of suitable size are used. The greensand granules are next boiled with a dilute solution of caustic soda, which loosens and removes the rest of the adhering clay, and they are then given a final rinsing before the stabilization treatment. This is an important part of the treatment, as stabilization or induration makes the granules hard and resistant to disintegration. Heat alone or in combination with a chemical treatment is the customary procedure for stabilization of the otherwise soft granules.

2. Treated Bentonite Clays; Fuller's Earth—At present the treated bentonitic clays do not form an important class of base exchangers. When they were first introduced their base-exchange capacity was so much higher than that of clays already in use that they found immediate favor. They continued to be in demand until about 1922, when the much faster acting glauconite superseded them. Even though the glauconites were of lower base-exchange capacity, they were preferred, and the clays never regained their former popularity in the field. Bentonites from the Dakotas were the principal source of clay for these zeolites. At the time the highest-grade bentonites occurred in Wyoming and the Dakotas, but more recently high-

grade bentonites have been found elsewhere, notably in California and Mississippi. The latter State is rich in these clays, which are used principally as high-grade activable bleaching clays.

A development that may be extremely important is the use of certain fuller's earths for zeolite. In England, where this type has been made, optimistic claims have been made for the exceedingly high base-exchange values, comparable to those of the precipitated synthetic group. Active investigation in this country may produce interesting results during the next few years and help to regain some of the prestige formerly held by the clays.

Synthetic Zeolites: 3. Precipitated or Gel Type: Sodium Aluminate, Sodium Silicate, and Sodium Hydroxide—The early types of precipitated zeolites were developed principally by Boehringer, P. deBrun, Rudorf, and Massatsch. Boehringer made a gel by the reaction of a solution of an alkali silicate, as water-glass, $Na_2O \cdot 3SiO_2$, with solutions of alkali salts of Al, Pb, Zn, or Sn. P. deBrun boiled a mixture of water-glass and Na aluminate solution and obtained a precipitate that was washed and dried and made soft, crumbly zeolite. Rudorf used the same chemicals and filtered off the mother liquor, but studied the effect of the formation of the precipitates and the mode of low-temperature drying on the exchange capacity of the finished zeolite. Massatsch removed only part of the mother liquor before drying and got a stronger zeolite on drying. All of these water softeners had fair base-exchange capacity but were slow acting. A big improvement in this class was made some years later by Behrman and independently by Wheaton, who dried the precipitate or the jelly with all mother liquor present.

Both of these investigators, by a careful control of factors such as concentration of reagents, temperatures, and time, made a jelly and dried it without breaking to get zeolite grains of greater capacity than had been obtained previously. Behrman used solutions of sodium silicate and aluminum sulphate to form his gel. The gel was dried at 60 to 80 deg. C., broken into small lumps, and granulated in water. The soluble salts left in the gel while drying were washed out subsequently and yielded a more porous mass. Wheaton, by careful control of the concentration of the solutions of sodium silicate and sodium aluminate, likewise obtained a complete jelly, which when dried without removal of mother liquor, crushed, and treated with water gave a good base-exchange compound. The best results were obtained by drying the gel at a mild heat to an alumina content of 6 to 16 percent. Riley was equally successful in making a gel by mixing solutions of sodium silicate, sodium aluminate, and filter alum. Improvements are still continuing, so that it is possible to make gel zeolites with operating exchange values running from 6,000 to 20,000 grains per cubic foot on 4 to 8 lb. of salt per cubic foot.

Chemically, the synthetic type of zeolite can be represented by the formula $Na_2O \cdot Al_2O_3 \cdot (SiO_2 \cdot (H_2O))$, or in the proportions of 1 mole of soda ash, 1 mole of alumina, 3 to 15 moles of silica, and a variable quantity of water. In a general sense a synthetic zeolite is a compound of a basic oxide such as soda, an amphoteric metal oxide such as chromium oxide, silica, and water of hydration. In Germany the synthetic base exchangers are called permutites, and this nomenclature is used to some extent in other countries.

First Commercial Synthetic Type of Zeolite

4. Fused Type: Feldspar, Clay, Silica, Soda Ash, and Alumina—The first commercial synthetic zeolites were made by the fused method. Feldspar, clay, and soda ash were melted in a suitable furnace and the melt was cooled, crushed, and leached with water to remove the soluble alkalies. The dried finished zeolite was screened, the fines were rejected, and the coarse granular product was sold as a water softener. These zeolites have operating exchange values of 4,000 to 8,000 grains per cubic foot on 4 lb. of salt per cubic foot. This was the first commercial type of water-softening reagent used extensively; however, the precipitated synthetics, with their tenuous gel structure, have high exchange values and faster regeneration and have gradually replaced the fused type so that at the present time sale of the latter is limited.

Miscellaneous: Lignite, Clay, Trass, Volcanic Rock—This group is unimportant, as none of the materials are used commercially. Lignite, clay, trass, volcanic rock, and other waste materials have been made into zeolites without apparent success, as the exchange capacities were too low to be of any practical value. Some attempts have also been made to produce a base exchanger by substituting borates for silica and the oxides of Pb, Sn, Ti, Zn, and Cr_2O_3 for alumina, but these likewise were obviously never used on potable waters.

Carbonaceous Cation Exchangers: Coal, Lignite, Peat and Wood—The class of water softeners made from such carbonaceous materials as coal, lignite, peat, and wood has emerged from the laboratory and is now available commercially. Their development has elicited considerable optimism regarding their usefulness in the water-conditioning field. This is especially true in the treatment of boiler-feed water where dissolved silica from zeolitic softener materials has long been a troublesome agent. The carbonaceous exchangers, being virtually free from silica, do not increase the silica content of the raw water and therefore have a distinct advantage over the older zeolites in this special field.

Bituminous coal, classed as a nonmetallic mineral, is the raw material now being used for the commercial production of carbonaceous exchangers. Which one of the bituminous coals is most satisfactory for this purpose still remains in doubt. A Bureau of Mines Report of Investigations (to be published) gives the results of treatment for base-exchange activity of several bituminous coals from Kentucky, Indiana, Virginia, West Virginia, and Alabama. An attempt was made to correlate the exchange capacity with some physical or chemical characteristic of the coal, but no such relation was found.

Carbonaceous cation exchangers can be operated as either a sodium or hydrogen exchanger. If regenerated with NaCl a sodium exchanger results, and if with dilute acid (HCl or H_2SO_4) a hydrogen exchanger results. The reported exchange capacity is somewhat different for each type; for the sodium exchanger 5,000 to 8,000 grains per cubic foot when using 0.35 to 0.50 lb. of salt per 1,000 grains of hardness removed, and for the hydrogen exchanger 8,000 to 9,000 of cations (sum of Ca, Mg, Na), all expressed as equivalent $CaCO_3$, per cubic foot when regenerated with 2.25 to 3.00 lb. acid (66° B. H_2SO_4) per cubic foot of material. Continued research very likely will increase these figures.

Organic Resin-Base Exchangers—Adams and Holmes, of England, in 1934 discovered that synthetic resins of the bakelite type could be made into base exchangers for cation removal of impurities in water. The broader claims of the patent cover the use of synthetic resins of the cationic type made by condensing mixtures of monohydric and polyhydric phenols or catechols and tannins with formaldehyde or other methylene bodies to remove certain cations from waters.

It is doubtful if these resins can compete favorably with the carbonaceous exchangers, for according to Adams and Holmes the synthetic resins are not as suitable or as economical as the carbonaceous exchangers, particularly in view of the fact that these resins require about twice as much regenerating acid as some of the commercially available carbonaceous exchangers.

(*To be continued*)

Excerpted from U. S. Bureau of Mines Report of Investigations 3578, by S. J. Broderick, Southern Experiment Station, Tuscaloosa, Ariz.